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D. E. SALMON, D. V. M., Chief of Bureau

CATTLE, SHEEP, AND HOG FEEDING IN EUROPE.

UNIVERSITY OF CALIFORNIA AT LOS ANGELES
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BY

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Animal Industry,
Washington, D. C., July 19, 1905.

Sir: I have the honor to transmit herewith a manuscript on the subject of cattle, sheep, and hog feeding in Europe, by Willard John Kennedy, B. S. A., of the Iowa College of Agriculture and Experiment Station. This work represents the major portion of Professor Kennedy's labors as special agent for this Bureau in Europe during portions of the years 1904 and 1905.

The investigations into European methods of feeding and management reported in the accompanying pages are particularly exhaustive in respect to cattle, and both the beef and dairy types receive an equal amount of attention.

The admittedly high quality of English, Irish, and Danish bacon renders the chapters dealing with the feeding of the bacon hog in the countries named of much interest to those of our farmers who are engaged in this industry.

In order that our live-stock men may be enabled to profit by these data, I recommend the publication of the work as Bulletin No. 77 of the Bureau series.

Respectfully,

D. E. Salmon,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

	Page.
Introduction	7
Part I.—Cattle:	
General aspect of the cattle industry in Europe	9
Conditions in the British Isles	10
England	10
Scotland	12
Ireland	13
Conditions in continental countries	14
France	14
Austria-Hungary	15
Germany	15
Switzerland	16
Denmark, Holland, and the Channel Islands	16
Beef and dual-purpose cattle—	
Methods of feeding in England	17
Feeding in Scotland	22
Irish methods of feeding	29
Feeding in France	32
Feeding methods in Austria-Hungary	35
German feeding methods	37
Dairy cattle—	
Dairy methods in Great Britain and Ireland—	
England	40
Scotland	43
Ireland	47
Dairy farming in Denmark	48
Feeding methods in Holland	55
Conditions in the Channel Islands—	
Jersey	57
Guernsey	61
Dairy feeding in France	63
Dairy methods in Austria-Hungary	65
Dairying in Germany	67
Swiss dairy methods	69
Part II.—Sheep:	
Sheep feeding and management in England	71
Sheep raising in Scotland	79
Sheep production in Ireland	85
The sheep industry of France	86
Part III.—Hogs:	
Hog raising in England	88
Hog feeding in Ireland	91
Hog feeding in Denmark	92
Methods of feeding in Austria-Hungary	95
The hog industry of Germany	96
Hog raising in France	97

CATTLE, SHEEP, AND HOG FEEDING IN EUROPE.

By WILLARD JOHN KENNEDY, B. S. A.,
Professor of Animal Husbandry, Iowa State College of Agriculture and the Mechanic Arts, and Vice-Director Iowa Experiment Station.

INTRODUCTION.

Many good authorities hold the opinion that any superiority of European breeding stock which may exist is due not so much to climatic conditions as to feed. With this suggestion in mind the writer devoted considerable time to the study of methods of feeding breeding animals, and found the task a difficult one because breeders often do not weigh their feed and are not always exact in the compounding of rations. However, he received many courtesies, and in cases where the daily feed had never before been weighed the managers gladly had this done and records kept for several days. For the many favors shown by the stockmen whom he visited and for the courtesies of the officials of departments of agriculture and American consuls the writer is under great obligations.

This report is not published with the expectation that the methods described can be adopted without change by American farmers, but it is probable that many of their features may be applicable to our conditions.

PART I.—CATTLE.

GENERAL ASPECT OF THE CATTLE INDUSTRY IN EUROPE.

In most European countries the cattle interests form one of the most important branches of the live-stock industry. A very wide range of feeding stuffs is used, and diversity of methods prevails both as regards the compounding of rations and the preparation of feed. However, satisfactory results are usually obtained, and the methods employed exemplify in no unmistakable manner that no one combination of feeding stuffs is superior to all others to produce work, meat, milk, or uniform growth and development. For reasons of economy the feeders of each country must use, as far as possible, the feeds whose production is best adapted to the soil and climatic conditions of that country, and which can be grown at home.

To an American the striking features of European methods are the large use made of roots, linseed and cotton cake, the large proportion of roughage to concentrates fed, the dependence placed on pasture and other green feed, the attention paid to the preparation of the feed, and the effort to use everything grown on the farm. Furthermore, although the most intensive methods are used to fatten cattle for market, the general tendency among breeders is to maintain breeding stock in good condition, but to avoid the extremely fleshy condition which often leads to barrenness and impotency.

Roots are most extensively used in cattle production in England and Scotland, and these crops are very highly valued. They are fed to dairy cattle as well as to beef animals, but when feeding them to milch cows the best dairymen take pains to avoid tainting the milk by their use. Mangel-wurzels (commonly called mangels or mangolds), turnips, and rutabagas (commonly called swedes) are usually grown in Great Britain. In the continental countries, especially in France and Germany, the sugar beet and sugar-beet pulp are used. In some cases carrots are fed, especially to calves, and in the island of Guernsey parsnips are used.

CONDITIONS IN THE BRITISH ISLES.

England.

The classes of English cattlemen are divided very much as in America. That is to say, there are the feeders, who buy all the stock they fatten; the dairymen; those who combine beef production and dairying; those who breed feeders only, and the breeders of pure-bred stock. Roots, cake, hay, and straw constitute the basis of winter rations, and a mixture of linseed cake and cotton cake, with grass or soiling crops, is the principal part of the ration during the summer. These rations are supplemented by a great variety of grain, commercial by-products, and proprietary feeds. Corn meal, bean meal, and pea meal are all used to some extent in fattening cattle or feeding dairy cows, but they are not fed in any quantity to young and growing stock intended for breeding purposes. For these animals crushed oats, wheat bran, and cake are the usual grain ration. In the central and northern districts turnips and swedes are also important crops. Mangels are better keepers than turnips and swedes and require a ripening process before they can be fed to best advantage; for this reason they are usually retained for late winter and spring feeding; yellow and white turnips are used during the early fall months, and swedes are available for the late fall and early winter. Roots are fed in varying amounts; some farmers use about 30 pounds, while others feed as high as 125 pounds per animal per day; the majority feed from 50 to 80 pounds of roots per head daily. They are usually fed between 8 and 10 a. m. and 4 and 6 p. m.

The amount of cake that is fed is astonishing. By this term is meant what we know as "cotton-seed meal" and "linseed-oil meal." They are usually combined with other feeds, but may be fed alone, especially during summer. Either or both are used. For convenience these feeds are generally referred to as "cake" in the following pages. This term is strictly applicable only to the product in the form in which it comes from the presses. When sold on our markets the cake has usually been ground into meal, but for convenience in exporting this is not usually done until the cake reaches its destination, and in many cases it is merely broken into small pieces and not ground. This makes it more convenient to feed, especially when it is thrown on the grass. British farmers use large quantities of undecorticated cotton cake, especially in summer feeding. This is the cake obtained in the process of oil milling where the hulls are not removed from the seeds. The hulls have an astringent property which is found valuable in counteracting the laxative effect of grass. Undecorticated cotton-seed meal is practically unavailable for American feeders. The only seed which can be economically milled without first having

the hulls removed is that to which no lint adheres in ginning. Egyptian and Sea Island seed have this characteristic. There is no Egyptian seed milled in America, and Sea Island seed is a very small factor. So far as is known to the writer all American mills remove the hulls as the first step in the milling process.

A great deal of attention is given to the preparation of feed in England, especially for dairy cows and fattening cattle. Grain is usually crushed or ground; chaffing, or cutting, straw and hay is a very general practice. Roots are usually pulped or sliced. In some parts of England farmers save all of the chaff at thrashing time and put it in a separate bin or stall from the straw, so that it may be mixed with the grain and cake at feeding time. This prevents the animals from bolting the grain and makes more complete mastication possible. Many good feeders mix cut straw or hay, pulped roots, and the grain and cake together before feeding. Some feeders moisten all such feed with boiling water. While these people have not given much attention to the study of the "balanced ration," they all feed special rations for special purposes.

Breeders strive to follow natural methods of feeding as nearly as possible. The use of highly concentrated feeds is limited and the use of forcing rations is deplored as being very injurious to future usefulness. In the opinion of the most successful breeders, forcing rations, while they may make the animal attractive to the eye, are very likely to weaken the constitution, reduce vigor, and exert an unfavorable influence on fertility. The general custom is to utilize grass, roots, and other natural feeds and to keep the animals out of doors or in open sheds the greater portion of the time. In discussing his methods of feeding, one of England's most noted present-day Shorthorn breeders, a man who stables only his herd bulls and young calves, everything else being fed in open yards or open sheds, said:

> The only cattle to which I feed artificial feeds and forcing rations are those intended for sale, because many buyers will not buy an animal in the rough. It is much easier to sell an inferior fat animal than a good one in a rough coat and thin flesh. By adopting this method of feeding, my best animals remain on the farm where I want them. Young heifers fed in this manner develop into useful breeding cows, and mature cows fed on natural feeds and kept out of doors invariably rear a good strong calf each year. Furthermore, since adopting this method of feeding and management I have never had any occasion to dread the visit of the United States Government veterinary inspector, as he seldom finds an animal which reacts.

The methods of feeding and management practiced on the farm of this breeder prevail on nearly all the best breeding farms in the southern and central parts of England. In the north of England breeders, as a rule, keep their animals in warmer buildings, but even there the cattle remain out of doors several hours each fine day during the winter months.

Scotland.

The farmers in all parts of Scotland are dependent in a large measure upon some phase of the cattle industry. This is true of those districts where the land is rough and not suited to cultivation, but it applies even more forcibly to the highly arable sections, where the annual land rents in some instances reach $15 per acre. In the production of cattle the Scottish live-stock men—under which term we must include every Scottish farmer, because the Scot, to all appearances, is born with a love for and a knowledge of live stock—have devoted their attentions to the development of the special beef and dairy breeds rather than the combination beef and milk animals.

Turnips and swedes are the principal roots fed, and they constitute a large part of the fall and winter rations for beef cattle. The amount fed varies a great deal, being greatest in the north of Scotland, where some feeders who are feeding 3-year-old steers give as much as 150 to 200 pounds per head per day. In the south of Scotland more grain and cake and smaller quantities of roots are fed. Yellow turnips are grown very extensively for breeding cattle, but swedes are preferred for fattening purposes. Roots grown in the north of Scotland are thought to have greater feeding value than those produced in the south.

The root crop is to the Scotch farmer what the corn crop is to the feeder in the American corn belt. The Scotch feeders are so accustomed to the use of swedes that they can hardly believe that cattle can be made fat during the winter season on a ration which does not contain at least a half hundredweight of them. While they sometimes change the roughage and concentrated feed in the rations, they never leave out the roots.

The "natural" methods used in England prevail in Scotland, particularly in the management of mature cows. They are fed simply and, therefore, economically. A fair amount of flesh adds to a cow's appearance and has a commercial importance when her calves are offered for sale, but the best breeders endeavor to avoid excessive fat, especially after a cow has had several calves, when she may become a "shy" breeder if allowed to become fat. Scotch breeders of beef cattle encourage young stock to develop early maturing qualities, particularly in Aberdeen-Angus and Shorthorn districts, and Galloway breeders are now using more liberal methods of feeding. As these breeds are bred almost entirely for beef production, the tendency to take on flesh rapidly and mature at an early age is regarded as the most important point to be considered.

In fattening cattle and feeding dairy cows a great deal of attention is given to the preparation of the feed. All grain is finely ground, much of the straw and hay cut, and on many farms the roots are

sliced. It is a very common practice to mix all of the grain and cake with cut roughage and pulped roots, and allow the mixture to stand several hours before feeding. On many farms this feed is either cooked or scalded with boiling water. From what could be learned from the feeders, cooking and steaming is not so generally practiced as in former years; the work involves a great deal of labor, and the results from uncooked feed are said to be quite as satisfactory. The prevailing custom appears to be to feed rather small allowances at frequent intervals.

Scotch farmers are not only good live-stock feeders, but they are also good feeders of the soil, and they believe that the most effective and economical method of feeding the soil is through the medium of live stock. In all cattle-feeding operations, especially on the arable farms, the feeder considers both the direct profits of feeding and the value of the manure, which is all saved and applied to the soil.

Ireland.

According to the most recent census reports, there are 4,677,182 head of cattle in Ireland, or one animal for every 4.36 acres of land in the entire country, which is a much larger number of cattle per 1,000 acres of land than is to be found in any other part of the United Kingdom or in continental Europe. Though the country is small the cattle interests are not by any means restricted to one special line, but cover a wide field, including special dairy farming, beef farming, cattle feeding, and the production of store cattle for feeding. The most extensive branches of the industry are the production of store cattle and dairy farming. The breeding of purebred cattle, especially of the beef breeds, is now becoming important. Although the winter feeding of cattle for beef production is carried on in some districts, it has not as yet received very much attention. Few countries afford so many natural advantages as Ireland from the standpoint of growing breeding cattle and those intended for store purposes. More than 80 per cent of the entire country is under grass for either grazing or hay purposes. In addition, there is an abundance of rain at all seasons of the year, which in connection with the mild climate, especially in the central and southern districts, renders it possible for animals to obtain the greater portion of their feed from pasture during the winter season.

The quality of the grass is usually good, containing as it does a high percentage of those nutrients which are so necessary to the proper development of the young and growing animal. This is especially true of the ash constituents, and more particularly in regard to the lime content; a limestone soil prevails in practically every part of the country. The Irish farmers are firm believers in

allowing nature to have her way, as rather than to cultivate the soil they choose to have their animals gather their feed in the form of grass. Ireland is a veritable grass country. The principal grain crop is oats, but barley, rye, peas, wheat, and beans are all grown in a more or less limited way. A rather large percentage of the cultivated land is utilized in the growing of potatoes and root crops, both of which, especially the root crops, are used for cattle feeding. Clover also grows well, but the greater portion of the hay crop is composed of mixed grasses.

CONDITIONS IN CONTINENTAL COUNTRIES.

FRANCE.

The soil and climate of France are favorable for crop growing, and farmers have a wide range of feeding stuffs at their command. Cattle raising is carried on in all parts of the country. The greatest number of cattle are to be found in the northern departments and the methods of feeding and management which prevail there are very much in advance of those which obtain in other parts of France. Although France can lay claim to having more than thirty breeds of cattle, there is not much diversity of type among them. To all appearances the characteristics which differentiate the various breeds are based more on color, marking, and locality than on type. The typical beef animal as seen in Great Britain or America is rarely found within the borders of France. The chief exception to this is to be found in a few of the British breeds which have been imported into France, but even these soon lose their original type. This is no doubt due to the fact that all animals are bred and maintained for at least two purposes—beef and milk—and in many instances for labor as well.

Unlike some continental countries, France is not confined to one general method of feeding her cattle. In the various parts of the country, and to a certain extent within the same districts, two, three, or even more rather distinct means of accomplishing the same end are pursued. This is especially true of the summer methods. In some districts, in fact more or less all over the country, the animals are grazed, while the use of soiling crops in connection with yard or stable feeding is very common and the system of tethering cows is very much in evidence. In all parts of the country a great deal of alfalfa and clover are grown. Corn is grown in the southern section and the common grains, grasses, and root crops are to be seen on every hand. Silage, especially that made from alfalfa and clover, is used on some farms and stands in very high favor. The growing of beets for sugar production furnishes a large amount of beet pulp for feeding. The practice of frequent feeding prevails in all parts

of the country. All kinds of grain are ground or crushed, and in some instances steamed or cooked before being given to the animals. Some farmers cut and chaff roughage and even soak or steam it, but the more general custom is to feed it in its natural form.

Austria-Hungary.

Austria-Hungary is a very productive country and on account of its varied soil and climatic conditions practically all kinds of forage crops are grown in large quantities. In few, if any, of the other continental countries is more attention given to the feeding of cattle. The greater portion of the cattle belong to the silver-gray and other native breeds, but the Simmenthal breed of Switzerland is also bred in many sections. All of these breeds are claimed to be dual-purpose animals, but the Simmenthal cattle show a strong inclination to the beef type, while the silver-gray and many other native breeds show unmistakable evidence of being high-class dairy animals. In some parts of the country cattle are used for labor, but the greater portion are bred and reared for beef or dairying, especially for the latter purpose. More or less attention is given to the growing of beef and the fattening of cattle in all parts of the country, but the mountains and grazing districts are especially used for this purpose.

Germany.

Although grain farming and sugar-beet production occupy the foremost place in German agriculture, the production of live stock is practiced to a certain extent throughout the entire country. Cattle are bred and maintained for meat and milk purposes and the dual-purpose type is used almost entirely. It is the general practice throughout all parts of Germany, except the northern, to stable or yard feed the cattle during the greater portion, if not all, of the year. In the northern part, where the land is not so valuable, they are pastured during the grass season. With these conditions prevailing the summer visitor to Germany is very likely to obtain a wrong impression of the live-stock interests unless he makes special visits to the farm buildings. Otherwise he might travel for miles and never see cattle of any kind. The German farmer considers it a wasteful practice to use land for grazing. By a well-planned system of soiling he is able to carry a large number of cattle on a very small area of ground, and the remainder of his small farm is available for the production of grain and root crops.

A variety of feeding stuffs is used. Leguminous crops are very commonly grown, clover being grown in all parts of Germany, while alfalfa is confined more to the southern and central districts. Corn

is grown for fodder only. Grain is always fed in moderate allowances. Considerable attention is given to the preparation of rations, and the practice of frequent feeding is quite prevalent, especially on the dairy farms.

Switzerland.

Swiss cattle are kept for milk, beef, and labor. Practically all of them belong to the two native breeds—the Brown Swiss and the Simmenthal—both of which are to be found in America. Dairy farming is conducted to a certain extent in all parts of the country, but beef is not produced in large quantities, the demand being largely supplied by beef imported from Italy and other countries. Cows, bulls, and oxen are used for labor.

The cattle are fed on very simple rations, running on pasture or being soiled in summer, and subsisting mainly on roughage during the winter. Owing to the limited amount of grain grown, concentrated feed is not used to any extent. In the more fertile valleys cows are stabled during the entire year. Calves usually run with the dams until weaned, but in some cases they are raised on skim milk or sweet whey with grain and green feed, or are sold as veal without other feed than the dam's milk or milk from the pail. In the latter case whole milk is fed for about two weeks, after which skim milk gradually replaces it.

Bulls which have outlived their usefulness, cows which are unprofitable in the dairy or too old too breed, and worn-out oxen are usually used for beef. If fed during the summer, they have nothing but grass; in the winter they have roughage as the principal feed, with a small grain allowance.

In some parts of the country it is customary for all the cows in a valley to be taken to the mountains for the summer, often to an altitude of 6,000 or 7,000 feet. The men in charge remain with them, milk them, and make cheese from the milk.

Although high-pressure feeding is entirely unknown in Switzerland, and the methods used tend to develop coarseness, the cattle are usually healthy and vigorous.

Denmark, Holland, and the Channel Islands (Jersey and Guernsey).

Practically all the cattle in these countries are strictly dairy bred, dairying being the principal live-stock industry. The discussion of the conditions in these places will be found under the head of Dairy Cattle.

BEEF AND DUAL-PURPOSE CATTLE.

METHODS OF FEEDING IN ENGLAND.

FEEDING YOUNG STOCK.

The methods of English breeders have many points of similarity with those in America. Young bulls are allowed to suckle the dams and are taught to eat as soon as possible. The rations are naturally composed of grain, hay, and roots. Young bulls are fed to somewhat higher condition than heifers, the latter having little if any grain or cake before weaning and the suckling period for them usually being shorter. Heifers are usually given plenty of fresh air and exercise.

Breeders of dual-purpose cattle very rarely allow their young stock to suckle. Bull calves are fed on whole milk or on a gruel of whole milk or skim milk with flaxseed meal, corn meal, or oatmeal. As they grow older barley meal, cotton cake, roots, and hay are added to the ration and the milk decreased. A rather fleshy condition is usually sought for.

Dual-purpose heifer calves are fed on skim milk and grain rations, and large amounts of proprietary calf foods are used. Skim-milk rations are usually prepared by boiling the grain in water and adding to the milk while still hot.

FEEDING BEEF BREEDING COWS.

Cows, especially when they are not in milk, are fed on very light rations. Dry cows are maintained on grass alone during the summer and on grass, hay, straw, and roots during the winter. The amount of roots fed is limited, as some cows are inclined to take on too much flesh when fed large quantities of them.

Good breeders do not feed grain or cake to dry cows except in the case of a cow badly out of condition or very old, when a small amount may be given. On some farms dry cows are not fed roots, being maintained solely on hay and the run of a grass lot for several hours each day. While cows managed in this way are rather thin in flesh and very rough in their coats, they are regular breeders and their calves command high prices. As calving time approaches better rations are fed, crushed oats, linseed, and wheat bran being generally used. The amount of roots fed is small until about ten days after the calf is dropped.

At calving time many breeders feed warm bran mashes, and some give tepid water for drinking purposes until the cow has regained her normal condition.

FEEDING BREEDING BULLS.

The breeders of both beef and dual-purpose cattle maintain breeding bulls in fairly high condition. The commercial end of the business renders it almost necessary for the breeder to practice methods of feeding which he well knows are not good for the sire, but sales of young stock are more readily made if there is a well-conditioned bull at the head of the herd. However, there are some exceptions to this, and on some of the best farms the most valuable sires are maintained in rather low condition. In these cases only the usefulness of the bulls is considered, and in the majority of such instances these sires are animals of established reputation and their offspring are eagerly sought for.

The rations used for young bulls are composed of some kind of hay (clover preferred), roots, and a mixture of crushed oats, wheat bran, and linseed cake, equal parts by weight; crushed oats, ground barley, and wheat bran, equal parts by weight, or ground barley, wheat bran, and linseed cake, equal parts by weight. The amounts range during the winter from 30 to 60 pounds of roots and from 6 to 12 pounds of grain, with what hay the animal will eat up clean. The summer rations include about the same grain rations, with hay and grass or other forage crops. In some instances breeders feed corn meal and cotton cake, but in the opinion of many both of these feeds should be omitted from the ration of the young breeding bull.

The rations for mature bulls are much the same as those for young bulls. The amount of roots fed varies from 40 to 80 pounds per day. The amount of grain fed varies with the condition of the bull and the amount of service required. In some instances as high as 15 pounds per day are given during the breeding season. Bulls which are required to do regular service throughout the year are fed from 6 to 9 pounds of grain per day. Those which are used heavily for a short time and then not used at all for several months receive little or no grain during the months they are not used.

FATTENING CATTLE FOR MARKET.

Cattle feeding is practiced to a certain extent in all parts of England. In addition to home-grown animals, store cattle of both Irish and Scotch breeding are fed in considerable numbers. Grass is used very largely in fattening, especially in those districts where rents are not too high.

The bulk of hay and straw is fed long, but a considerable amount is cut and mixed with cake and grain. Some feeders pulp all roots fed, but the more general practice is to feed them whole. Cattle which are teething are sometimes given pulped or sliced roots, but

on many farms no change is made. Frequent feeding prevails. The general tendency in all parts of the country is to market cattle at a much earlier age than in former years, but the production of baby beef is very limited in extent, and confined almost solely to Herefordshire or other localities where Hereford cattle are bred.

FATTENING CATTLE DURING FALL AND WINTER.

Although the feeding of beef cattle is not always profitable from the standpoint of the gains produced, the manure obtained is a valuable asset to the English farmer, especially where large quantities of cake are fed. In general there is not a very marked difference in methods. Cattle are fed in stalls or in yards. The amount of roots fed per day varies from 30 to 100 pounds per head, according to the amount of grain and cake used. The amount of concentrates varies from 6 to 15 pounds per animal per day, but the majority of feeders use from 10 to 12 pounds for animals on full feed. As a rule, the most successful feeders take four months or more to get their animals on full feed. The cattle are put in the feed yards or stalls any time from the first of October until the middle of November, and they are marketed from the first of March until the middle of June; after that time grass-fed cattle are very much in evidence. The feeding period varies, therefore, from one hundred and twenty to about two hundred days.

To a person who has been accustomed to the methods of cattle feeding which prevail in the American corn belt the grain rations fed by the English feeders look very small, but the gains made by the cattle are fully as great as those obtained by the most successful American feeders, a fact which demonstrates that the English method of feeding must insure more thorough digestion of the grain and cake, or the roots must furnish more nourishment than the chemical analyses would seem to indicate. The following rations are representative of those in use:

Farm No. 1.—This farm is located in the south of England, in Sussex, and the manager is said to be one of the most successful feeders in his district. This ration was being fed in January to cattle which had been on feed since the first of October: Mixed hay, 15 pounds; oat chaff, 4 pounds; mangels, 30 pounds; linseed cake, 3 pounds; cotton-seed cake, 3 pounds; ground barley, 3 pounds; crushed oats, 2 pounds; and corn meal, 3 pounds. The cake and meal were fed morning and evening with the oat chaff. The mixed hay was fed in the early morning, in the afternoon, and the last thing at night, while the roots were fed about 9 o'clock in the forenoon.

Ration for steers fed in Sussex, England.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	15	13.065	0.885	6.135	0.180	.....
Oat chaff	4	3.428	.060	1.320	.028	.....
Mangels	30	2.730	.330	1.620	.030	.....
Linseed cake	3	2.724	.879	.981	.210	.....
Cotton-seed cake	3	2.754	1.116	.507	.366	.....
Ground barley	3	2.673	.261	1.968	.048	.....
Crushed oats	2	1.780	.184	.946	.084	.....
Corn meal	3	2.673	.237	2.001	.129	.....
	.....	31.827	3.952	15.478	1.075	1:4.50

Farm No. 2.—This farm is located in Norfolk, one of the leading beef-producing districts of England. The manager always feeds a large number of cattle during the fall and winter months. They are purchased in September or early in October and are given the run of a grass lot for six weeks, during which time they are taught to eat white turnips and cake. The amount of cake is gradually increased so that at the end of the six weeks they are eating from 6 to 8 pounds of grain per head daily. Cattle on full feed receive 12 pounds of mixed hay, 5 pounds of oat straw, 70 pounds of swedes, 3 pounds of cotton-seed cake, 3 pounds of linseed cake, and 3 pounds of ground barley.

Ration for steers fed in Norfolk, England.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	12	10.452	0.708	4.908	0.144	.....
Oat straw	5	4.540	.060	1.930	.040	.....
Swedes	70	7.000	.700	5.600	.140	.....
Cotton-seed cake	3	2.754	1.116	.507	.366	.....
Linseed cake	3	2.724	.879	.981	.210	.....
Ground barley	3	2.673	.261	1.968	.048	.....
	.....	30.143	3.724	15.894	.948	1:4.84

Farm No. 3.—This farm is located in the north of England, in Northumberland. Swedes are used in large quantities—from 60 to 100 pounds per animal being fed daily. For roughage mixed hay and oat straw are used; as a rule about half and half of each are fed, but the proportions are varied according to the supply available. Except cotton-seed cake and linseed cake, both of which are always fed, the concentrated part of the ration varies with the prices of feed, and is composed of one or more of the following: Crushed oats, ground barley, corn meal, rice meal, bean meal, and pea meal. In February,

cattle on full feed were receiving the following ration: Cotton-seed cake, 4 pounds; linseed cake, 2 pounds; crushed oats, 4 pounds; mixed hay, 8 pounds; oat straw, 6 pounds; and swedes, 80 pounds.

Ration for steers fed in Northumberland, England.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	8	6.968	0.472	3.272	0.096	.....
Oat straw	6	5.448	.072	2.316	.048	.....
Swedes	80	8.000	.800	6.400	.160	.....
Cotton-seed cake	4	3.672	1.488	.676	.488	.....
Linseed cake	2	1.816	.586	.654	.140	.....
Crushed oats	4	3.560	.368	1.892	.168	.....
	.....	29.464	3.786	15.210	1.100	1:4.67

Farm No. 4.—This farm is located in Gloucester. Cattle on full feed are fed daily per head 15 pounds of mixed hay, 3 pounds of oat chaff, 50 pounds of swedes, 3 pounds of cotton-seed cake, 2 pounds of linseed cake, 4 pounds of ground barley, and 3 pounds of corn meal. The hay is fed in three feeds—morning, noon, and night; the grain and cake are mixed with the oat chaff and fed in two feeds—morning and evening; the swedes are fed about 9 a. m. and 4 p. m.

Ration for steers fed in Gloucester, England.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	15	13.065	0.885	6.135	0.180	.....
Oat chaff	3	2.571	.045	.990	.021	.....
Swedes	50	5.000	.500	4.000	.100	.....
Cotton-seed cake	3	2.754	1.116	.507	.366	.....
Linseed cake	2	1.816	.586	.654	.140	.....
Ground barley	4	3.564	.348	2.624	.064	.....
Corn meal	3	2.673	.237	2.001	.129	.....
	.....	31.443	3.717	16.911	1.000	1:5.15

FATTENING CATTLE ON GRASS.

Cattle are fattened on grass in all parts of England, but this is not extensively done except where rents are low or where land is subject to overflow and is kept in permanent pasture.

Many fall and winter feeders feed cake on grass for several months until the cattle are half fat before putting them in the yards or stables. The allowance at first is very small—perhaps 1 pound per day—the amount being gradually increased until the animals are eating 4 or 5 pounds per head daily at the end of the grass period.

Others fatten their cattle on grass alone until a month or six weeks previous to marketing time, when some cake is given.

In all parts of the country there are feeders who endeavor to finish their cattle on the grass land or have them forward enough by the 1st of October so that from three to six weeks' yard feeding on hay, roots, and cake will make prime animals. Where this is done undecorticated cotton cake, or a mixture of this cake and linseed cake, is fed throughout the entire summer. Early in the season from 2 to 3 pounds per head per day are fed, but the amount is gradually increased at the rate of 1 pound per month, so that the cattle are very often eating from 7 to 9 pounds per head daily at the end of the grass period.

FEEDING IN SCOTLAND.

Scotch farmers have given to the world some of its best beef breeds; they have been fully as successful in feeding animals for beef, and from the standpoint of quality and flavor Scotch-fed beef has held for many years the leading position in the most critical meat markets of the world. This is remarkable, because Scotch beef is not produced in any one locality, or confined to any one class of farmers, but is produced on practically all farms, large and small, within the boundaries of Scotland. The number of cattle fed by an individual is not usually so large as in America, and depends upon the amount of roughage and roots available.

In former years many of the north of Scotland cattle feeders in fattening three-year-old and four-year-old cattle fed nothing but straw and swedes. This method of feeding does not now prevail to the same extent, as the tendency on every hand is to market animals at an earlier age, and grain and cake have been added to the rations. Breeding animals, however, are still fed large quantities of roots by many stockmen, and in such cases not much grain and cake is given.

FEEDING BREEDING CATTLE.

With the exception of bulls, breeding cattle of all ages are kept on pasture when the weather permits. Calves run with their dams on grass as soon as it comes. Bull calves begin to eat grain while still on pasture. With the approach of winter the feed is increased.

In northwest Scotland Shorthorn and Angus bull calves are fed very liberally until ready for sale, which is when they are between 12 and 18 months of age. Hay is usually fed long, and roots are sliced or pulped. The amounts given are from 10 to 15 pounds of hay, 30 to 60 pounds of roots, and 6 to 12 pounds of grain. Some grain rations are: Linseed cake 2 parts, wheat bran 1 part, crushed oats 1 part; crushed oats, linseed cake, and ground barley or corn

meal, equal parts; bran and linseed cake equal parts. This is the feeding during the first winter.

Heifer calves are not usually fed grain while suckling, and are not made excessively fat, but kept in good growing condition. Some breeders feed no grain or cake, maintaining them on turnips and hay during the winter, but the majority feed crushed oats and linseed cake. The only heifers which are forced at all are those intended for show, and their rations contain large quantities of roots, a considerable amount of hay, and a comparatively small amount of grain and cake. Scotch breeders believe that when fed in this way heifers are not seriously injured for breeding. They have the fresh, sappy appearance of grass-fed cattle in June, and three-year-old heifers which had been fed in this way did not seem to have suffered by it.

In no other line of cattle feeding in Scotland does such uniformity of method exist as in the feeding of breeding cows. After the calves are weaned the cows are allowed the run of a grass lot until severe weather renders it necessary to furnish shelter and winter rations. At this time some breeders tie their cows in stalls, but the more general custom is to furnish loose stalls for individual cows or large covered courts where a number may run together. From the time they are housed until within three or four weeks of calving they are maintained solely on turnips and roughage. The amount of turnips fed varies from 60 to 150 pounds per cow per day. The racks are usually kept well filled with straw at all times and the turnips are fed in two or three feeds, more generally two feeds, one in the late morning and the other about 3 or 4 p. m. The roots are nearly always fed whole to mature cows, but they are very often sliced or pulped for young cows or heifers which are shedding their teeth.

As calving time approaches, the cows are generally placed in box stalls or tied in open stalls and fed more liberally, a grain ration being added. At calving time and for a week or ten days after, many breeders give warm bran mashes and in some instances all the drinking water is warmed. After this the feeding is liberal until grass arrives. Some of the grain rations fed cows with calves are: Ground barley, bran, and linseed cake, equal parts; dried brewers grains, ground barley, and linseed cake, equal parts; cotton cake sometimes takes the place of part of the linseed cake. When grass becomes plentiful, additional feed is not usually supplied.

Breeding bulls are fed liberally until they have proved themselves to be superior stock getters, buyers always judging a young bull's ability to sire good beef cattle by his own condition. Some of the winter grain rations fed yearling and two-year-old bulls are: Crushed oats, 2 parts; wheat bran, 1 part; ground or cooked barley, 1 part;

linseed cake, 2 parts; crushed oats, wheat bran, linseed cake, equal parts; crushed oats and linseed cake, equal parts. The grain ration is fed in two feeds, morning and evening; some breeders mix it with oat chaff or cut hay before feeding. The rations in the summer are very much the same, green forage taking the place of the roots.

Some breeders do not feed grain and cake to mature bulls and, at any rate, less cake and barley and more oats and bran are used than for younger bulls. The allowances of roughage and succulent feed are proportionately larger in all cases and that of concentrates less. Some of the grain rations for these animals are as follows: Crushed oats and wheat bran, equal parts; crushed oats, 2 parts, wheat bran, 2 parts, linseed cake, 1 part; crushed oats, 3 parts, wheat bran, 2 parts, ground barley, 1 part, and linseed cake, 1 part; crushed oats, wheat bran, and linseed cake, equal parts.

THE PRODUCTION OF BEEF.

The growing and fattening of cattle for beef engages the attention of the farmers to a certain extent in all sections of Scotland. Throughout the Highlands the breeders of Highland cattle grow store, or feeding, animals, and in the arable districts it is the exception to find a farmer who is not in some way connected with the beef industry.

If two-year-olds and three-year-olds are fed, a great deal of roughage is used. The amount fed young animals is not so great and the quality is better. Oat, barley, and wheat straw and the various kinds of hay are used. The amount of oat straw used is astonishing, especially in feeding more mature animals.

Sources of feeding cattle.—Feeders get their stores from Ireland, from southwest Scotland, from the Highlands, or in their own neighborhood from small farmers.

The age of the Irish cattle when purchased varies from 12 to 30 months, but the most of them are about 18 months old; the Galloways from the southwest are from 12 to 20 months old, the Highlands from 3 to 4 years, and the local stock from 1 to 2 years.

Beef production on high-priced land.—In addition to the stockmen who purchase their feeders there is a considerable number who grow all the animals they feed, and this work is successfully done in some instances where land rents for $12.50 per acre. Some of these farmers purchase calves when a few days old and raise them on nurse cows, and this is successful if good calves are secured. In some instances feeders furnish high-class beef sires to the owners of cows, so that the calves will be of the desired feeding type. These men aim to have their cattle ready for market before they are 2 years old. The calves are taught to eat at an early age and are very

liberally fed until ready for the market. Another successful method is when open heifers about 20 months old are purchased in the fall in the Galloway district or in Ireland and maintained as economically as possible until March, when they are bred to a high-class beef sire. Black bulls are generally used on heifers of mixed color, and Shorthorn bulls on black heifers, so that the calves will be uniform in appearance. The heifers are grazed during the summer and do not receive any special care or additional feed until the latter part of October or the first of November. From this time on they are fed on hay, roots, and very often a small allowance of grain and cake, so as to be in good condition at calving time. After calving they are liberally fed. When the grass season opens they are put on pasture and fed from 5 to 10 pounds of grain and cake per day in addition. The calves are weaned about the 1st of September and three months' additional feeding makes the dams ready for the butcher.

The advantages claimed for this method are that the heifers are growing all the time and increasing in value, that they will rear good calves and still sell in the open market not as cows but as fat heifers. As a rule they are purchased for about $40 each and sell for $80 or $90. On some farms the heifers raise a second calf before being sold. Where this method prevails one-half of them are sold as milch cows after dropping the second calf, and the others are made to suckle two calves each, are bred a third time, and sold as milch cows after dropping their third calf, or are fed heavily during the second lactation period and finished for beef.

The calves are taught to eat at an early age and are heavily fed; they run with the mothers on grass and receive all the grain and cake they will eat up clean, the feeding being increased as they will take it, at the rate of half a pound or a pound a month. They are weaned early in September and from that time on are housed and well fed until ready for market the following April or May. During this time they are fed 10 to 15 pounds of mixed or clover hay, 20 to 50 pounds of turnips or swedes, and a grain mixture composed of linseed cake, cotton cake, dried brewers' grains, and corn or barley meal, equal parts; linseed cake, crushed oats, pea meal, and ground barley, equal parts; linseed cake, cotton cake, crushed oats, and corn meal, equal parts. The amount of grain fed varies from 10 to 14 pounds per animal per day, according to age and size. The best feeders use more linseed cake and less cotton cake when swedes are fed than when yellow turnips are fed.

Fattening cattle.—The age and condition of cattle at the time of purchase influence the methods of feeding. A great many feeders purchase young animals in thin flesh in the fall and carry them through the winter on light rations, gradually increasing the amount

of cake fed, so that by May, when the grass season opens, they will be eating about 4 pounds per day. They are then put on grass and the cake is increased at the rate of 1 pound per month, so that they will be eating 8 or 9 pounds per day by the middle of September or the first of October, when they are put in yards to be finished in six to ten weeks on hay, roots, grain, and cake.

In fall and winter feeding cattle are fed in closed courts or tied in stalls, and the length of the feeding period varies from six weeks to seven or eight months. Cattle which have been carried through the previous winter on light rations and fed cake with grass during the summer months require but a short period of feeding to put them in good condition. On the other hand, thin animals with large, coarse frames require several months to round them out in marketable condition.

The following rations are fairly representative of prevailing methods of feeding. In each instance the ration is that used when the animals are on full feed.

Farm No. 1.—This farm is located in the extreme south of Scotland, in the midst of the Galloway breeding district. The cattle on feed would weigh in the neighborhood of 1,200 pounds and had been fed cake on grass all summer: they were almost finished at the time of the writer's visit early in November. The following ration was fed: 90 pounds swedes, 7 pounds oat straw, 6 pounds mixed hay, 3 pounds crushed oats, 4 pounds bean meal, and 4 pounds of linseed cake. The swedes were fed in three feeds—morning, noon, and evening: the grain and cake in two feeds—morning and night; the hay in the morning, and the straw at night.

Ration for steers fed in southern Scotland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Swedes	90	9.900	0.900	7.290	0.180	.....
Oat straw	7	6.356	.084	2.702	.056	.....
Mixed hay	6	5.226	.354	2.454	.072	.....
Crushed oats	3	2.670	.276	1.419	.126	.....
Bean meal	4	3.428	.896	1.972	.048	.....
Linseed cake	4	3.632	1.172	1.308	.280	.....
	.....	31.212	3.682	17.145	.762	1 : 5.12

Farm No. 2.—This farm is located in Perthshire and is the seat of extensive cattle-feeding operations. The cattle are fattened at an early age and are marketed at about 1,200 pounds live weight. The ration fed during February to cattle which had been on feed since the middle of October and were to be marketed early in April was

composed of 15 pounds oat straw, 5 pounds oat chaff, 70 pounds swedes, 10 pounds potatoes, 4 pounds linseed cake, and 4 pounds of cotton-seed cake. The straw was put in the racks in the morning, the cake was mixed with the oat chaff and fed in two feeds—morning and night; and the swedes were fed in two feeds—at 8 a. m. and 4 p. m. The cattle were in a large covered court.

Ration for steers fed in Perthshire, Scotland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Oat straw	15	13.620	0.180	5.790	0.120	.....
Oat chaff	5	4.285	.055	1.650	.035	.....
Swedes	70	7.700	.700	5.670	.140	.....
Potatoes	10	2.110	.090	1.630	.010	.....
Cotton-seed cake	4	3.672	1.488	.676	.488	.....
Linseed cake	4	3.632	1.172	1.308	.280	.....
	.....	35.019	3.705	16.724	1.073	1 : 5.17

Farm No. 3.—This farm is located in the Midlothian district, near Edinburgh. The tenant pays an annual rent of $12.50 per acre for the land. He does not buy feeders, but purchases heifers, raising only one calf from them and then fattening them for market. He therefore breeds his own feeders. They are finished for market at from 17 to 18 months of age. The following ration was fed in February, when the animals were about 15 months old and weighing on an average about 1,000 pounds: 12 pounds mixed hay, 60 pounds swedes, 3 pounds linseed cake, 3 pounds cotton-seed cake, 3 pounds ground barley, and 2 pounds corn meal. The hay was fed in two feeds—morning and evening; the grain and cake also in two feeds—morning and evening; and the swedes in three feeds—morning, noon, and night.

Ration for steers fed near Edinburgh, Scotland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	12	10.452	0.708	4.908	0.144	.....
Swedes	60	6.600	.600	4.860	.120	
Linseed cakes	3	2.724	.879	.981	.210	
Cotton-seed cake	3	2.754	1.116	.507	.366	
Ground barley	3	2.673	.261	1.968	.048	
Corn meal	2	1.782	.158	1.334	.086	
	.....	26.985	3.722	14.558	.974	1:4.50

Farm No. 4.—This farm is located in Aberdeen, in the very center of the greatest cattle-feeding district in Scotland. At the time of the

writer's visit the tenant was feeding about fifty head of high-grade and purebred Shorthorn cattle, which would average about two and a half years and weigh about 1,400 pounds each. The ration fed was a very simple one, composed of 15 pounds oat straw, 5 pounds oat chaff, 130 pounds swedes, 4 pounds linseed cake, and 4 pounds cooked barley. The straw was put in the feed racks every morning, the cooked barley and linseed cake were mixed with the oat chaff and fed in the evening, and the swedes were fed in three feeds—morning, noon, and early evening.

Ration for steers fed in Aberdeen, Scotland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Oat straw	15	13.620	0.180	5.790	0.120	.....
Oat chaff	5	4.285	.075	1.650	.035	.....
Swedes	130	14.300	1.300	10.530	.260	.....
Linseed cake	4	3.632	1.172	1.308	.280	.....
Cooked barley	4	3.564	.348	2.624	.064	.....
	.....	39.401	3.075	21.902	.759	1:7.68

Farm No. 5.—This farm is located in Forfarshire, which is also a noted cattle-feeding district. In this district the feeders use more barley straw and hay than the feeders in the extreme northern counties. Rice meal is also fed on many farms. On the farm in question the manager was feeding a large number of high-grade Angus heifers which had been on feed over four months. They were about two and a half years old and would average about 1,100 pounds live weight. The ration in use consisted of 10 pounds barley straw, 5 pounds mixed hay, 90 pounds swedes, 5 pounds rice meal, 3 pounds cotton-seed cake, and 2 pounds linseed cake. The straw was put in the feed racks in the morning, the hay was cut and mixed with the rice meal and cake and fed in two feeds, morning and evening. The swedes were sliced and fed in three feeds—morning, noon, and early evening.

Ration for steers fed in Forfarshire, Scotland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Barley straw	10	8.580	0.070	4.120	0.060	.....
Mixed hay	5	4.355	.295	2.045	.060	.....
Swedes	90	9.900	.900	7.200	.180	.....
Rice meal	5	4.500	.450	1.750	.500	.....
Cotton-seed cake	3	2.754	1.116	.507	.366	.....
Linseed cake	2	1.816	.586	.654	.140	.....
	.....	31.905	3.417	16.366	1.306	1:5.68

Practically every feeder feeds from 60 to 120 or 130 pounds of swedes per animal per day, and the rest of the ration is usually composed of such roughage as is available and concentrates. At least one-half of the latter would be cake, and the remainder is made up of home-grown grains which have been damaged from a market standpoint or other cheap and easily obtained feeds. Yellow turnips are sometimes fed in the fall instead of the swedes, but the latter are much more popular for fattening and are nearly always used.

IRISH METHODS OF FEEDING.

BREEDING CATTLE.

Few countries are better adapted to the production of vigorous breeding stock than is Ireland, and this industry promises to make very rapid development in the near future. With more rigid demands from Great Britain for quality in feeders, a strong demand has developed for purebred beef sires, and many of the more progressive Irish farmers have established herds to supply it.

Methods of feeding show considerable uniformity, and the most prevalent custom is to allow the cows to nurse their calves until 7 or 8 months old. Some good breeders milk their cows and feed the calves on whole milk. The feeding of the cows is much the same, regardless of how the calves are reared. During the late spring, summer, and early fall they are pastured and no additional feed is given, unless the pastures are short, which does not often happen.

The winter methods of feeding vary according to climatic conditions. In the south and central portions of the country the cows are allowed to spend several hours each day in the pasture, and it is said that herds managed in this manner seldom, if ever, contain tuberculous animals. During the early part of the winter, while the cows are dry, the stable ration consists of one feed of oat straw, one feed of mixed hay, and from 50 to 80 pounds of turnips per cow per day. No grain of any kind is given, and the cows not only maintain their condition, but rapidly increase in flesh. The calves are generally dropped between the first of January and the latter part of April. About three weeks previous to calving each cow is fed from 3 to 8 pounds per day of a mixture of equal parts by weight of crushed oats and bran. This grain mixture is usually given dry until calving time, but thereafter it is made into a thick mash with boiling water. The ration otherwise remains the same: the cow is usually confined to the stable for a week or ten days, after which she is allowed access to the grass lot for several hours each day during favorable weather.

In the northern part of Ireland the cows are confined to the stable during the greater part of the winter. During the early winter they are fed on oat straw and turnips, and may receive some mixed hay

as well. They are fed from 60 to 100 pounds of turnips per head daily, and on some farms even larger quantities are given. The amount of straw fed is governed only by the appetite of the cow, as she is given all she will eat. More care is observed in feeding hay, the amount seldom exceeding 15 pounds per cow per day. It is claimed that dry cows will nearly always increase in flesh on these rations. From two to four weeks previous to calving time a small allowance of grain is given. A mixture of crushed oats and bran, or ground barley and bran, is generally fed at this time. After calving the grain mixture is usually made into a thick mash with boiling water. The amount of turnips is increased about 25 per cent and is fed in three feeds instead of two feeds per day.

Breeding bulls are rather closely confined both summer and winter. A small, open paddock is usually provided for exercise; on some farms they have a grass lot instead. The rations fed during the winter are usually composed of hay and turnips, with a small allowance of concentrated feed. Sixty to 80 pounds of roots daily is the usual amount, and from 5 to 12 pounds of grain, according to the bull's condition and the amount of service required. In summer green forage replaces the roots.

No attempt is made to pamper young stock, but great care is taken to retain the milk flesh. Young bulls are fed more liberally than heifers.

THE PRODUCTION OF STORE CATTLE.

Generally speaking, Irishmen use no method in producing store, or feeding, cattle. They are usually bred regardless of type or color. In only a few cases are purebred sires used or is the feeding liberal. The large proportion of them are produced by small tenant farmers, and the animals have to shift for themselves most of the time.

On the larger farms the calves are, in addition to the run of a grass lot, usually fed skim milk and very often a small allowance of grain or cod-liver oil to replace the butter fat taken out of the milk. Recent experiments conducted by the department of agriculture of Ireland have demonstrated that cod-liver oil is an excellent feed with skim milk for calves. Calves fed on a ration of skim milk and cod-liver oil made practically as large gains as those fed on whole milk, and much greater than those fed on corn and milk. Flaxseed is also used. Calves reared in this manner during the summer and liberally fed and comfortably housed during the first winter do exceptionally well the following summer and sell well in Great Britain.

FATTENING CATTLE.

The fattening of cattle is gradually increasing in importance. Stall feeding is largely confined to the central part of the country,

and to Ulster in the north; but summer feeding is practiced in all parts of the country. When fed on grass, cake and grain are seldom given. Many farmers, especially in central and southern Ireland, feed two lots of cattle per year on their pasture, the first being marketed in May and the second in November.

Cattle fattened during the winter in stalls are fed from three to four months if in fairly good flesh at the start, but the average require from five to seven months' feeding to finish them. In the north of Ireland a great deal of attention is given to the steaming of concentrated feed and the cutting and slicing of roots. Frequent feeding—from three to six times per day—is the prevailing custom. On some of the best farms stall-fed animals are groomed once or twice per week, and the practice is considered very beneficial. The age of the cattle varies from 12 months to 3 years or over. Young cattle are fed more cake and less roughage than 3-year-olds.

The following are representative rations:

Farm No. 1.—This is a medium-sized farm near Dublin, where the owner feeds about 50 head of young steers each winter, ranging in age from 15 to 18 months. They are fed in a covered court. When on full feed the ration consists of mixed hay, 15 pounds; turnips, 40 pounds; crushed oats, 4 pounds; corn meal, 3 pounds, and linseed cake, 3 pounds. The hay is given in two feeds, the turnips in two feeds, and the grain ration in two equal feeds—morning and evening. The cattle make very satisfactory gains on this ration.

Ration for steers fed near Dublin, Ireland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	15	13.005	0.885	6.135	0.180	.....
Turnips	40	3.600	.400	2.880	.080	.....
Crushed oats	4	3.560	.368	1.892	.168	.....
Corn meal	3	2.673	.237	2.001	.129	.....
Linseed cake	3	2.724	.879	.981	.210	.....
	.....	25.622	2.769	13.889	.767	1:5.64

Farm No. 2.—This farm is located in County Down, in the north of Ireland, in the midst of one of the greatest cattle-feeding districts in the country. The owner feeds about 200 head of cattle each year, varying in age from 2 to 3 years. In this section more dependence is placed on straw and turnips than in the central districts. Oats are generally used with cake, but both barley and corn are used in considerable quantities. Both linseed cake and cotton cake are fed, and prepared cakes are used to some extent. On the farm in question the following ration is fed: Oat straw, 12 pounds; mixed hay, 8

pounds; turnips, 80 pounds; crushed oats, 3 pounds; ground barley, 3 pounds; linseed cake, 2 pounds, and cotton-seed cake, 2 pounds. Hay is given in the morning, straw at night, and the grain and roots in two equal feeds—morning and evening. The roots are sliced.

Ration for steers fed in County Down, Ireland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Oat straw	12	10.896	0.144	4.632	0.096	.....
Mixed hay	8	6.968	.472	3.272	.072	.....
Turnips	80	7.600	.800	5.760	.160	.....
Crushed oats	3	2.670	.277	1.419	.126	.....
Ground barley	3	2.673	.261	1.968	.048	.....
Linseed cake	2	1.816	.586	.654	.140	.....
Cotton-seed cake	2	1.836	.744	.338	.244	.....
	.....	34.459	3.283	18.043	.886	1:6.1

In some instances more hay is fed than in this ration; in others nothing but oat straw is given for roughage. The amount of turnips varies from 60 to 100 pounds. The grain ration in some instances is composed of barley and cake or corn and cake, but on the majority of farms some oats are fed. In some instances the roots are fed whole. To one accustomed to the use of heavy grain rations it is remarkable to note the extent to which the grain ration can be replaced by turnips and roughage. The increase in weight obtained by the use of these rations ranges from 2 to 3½ pounds per steer per day.

FEEDING IN FRANCE.

BREEDING CATTLE.

Calves are taught to eat at an early age, and young stock are developed in a simple manner. Great dependence is placed on green forage and silage, and some farmers feed beets and carrots. The amount of grain fed is small. Bulls intended for breeding are somewhat better fed than heifers.

Breeding bulls are maintained in fair flesh. During the summer green feed is supplied. The winter ration consists of clover or alfalfa hay and straw, with roots when available. Grain is not fed to mature bulls, except when they are used heavily or are in poor condition. On many farms the bulls are given regular work. They may be used either singly, in pairs, or with an ox. Regular work insures regular exercise and a good disposition. It is also said that bulls managed in this way get a much larger percentage of calves than when confined in a stable or paddock.

WORK CATTLE.

The American does not usually associate the use of oxen for labor with progressive farming, but in France they are to be found side by side with the latest and most highly improved labor-saving machinery. When asked why he retains oxen for farm labor, the French farmer invariably replies that they are more economical than horses. On an estate where very accurate accounts are kept of every detail the manager claims that four oxen do the same amount of work as three horses, and that the cost of a day's work of a 4-ox team is $2.50, while that of a 3-horse team is $3.54. It is also said to cost much less to grow an ox to working age than it does a horse, and he can be sold as beef at any time. As little grain as possible is fed, and the rations are composed of the cheapest feeds obtainable.

FATTENING CATTLE.

The French farmers produce large quantities of beef and all sorts of animals are used, from the 2-year-old steer to the worn-out dairy cow or work ox. By far the largest numbers are finished during the summer, especially where grazing is possible, and some prominent farmers claim that were it not for the fact that beef is in demand at all seasons of the year, winter feeding would be abandoned in France.

To meet the regular demand more or less stall feeding is done, and on some farms it is conducted on a very extensive scale, but where grazing is practiced the general custom is to finish the animals on grass alone. When the pastures are short, some additional feed may be needed, when a ration of about 3 pounds per animal per day of cotton cake is generally used. Linseed cake is used to some extent, but is preferred for winter feeding, and corn or a mixture of corn and cotton cake is used in some sections. Light rations are given. When cattle are fed in the yard or stable in summer, they are soiled on alfalfa and clover. In some instances beet pulp, which has been stored in long pits, is used with good results.

In winter the grain ration consists of about 3 pounds per animal at the beginning and is gradually increased to 8 or 10 pounds, which is considered a heavy grain allowance even during the finishing period. Home-grown roughage is generally used. Practically all feeders commend the use of succulent feed for winter feeding. Compared with American systems, the grain rations are much lighter (less than one-half), and the amount of roughage fed is about double. The gains per day are about two-thirds the amount obtained by the best American feeders. Representative winter rations are as follows:

Farm No. 1.—This is a large farm in the north of France, where a considerable number of cattle are fattened each winter. On this farm there is a large silo and a sugar distillery. The silage is made of green alfalfa and clover, and is excellent. The sugar distillery supplies a large amount of beet pulp. Three different rations have been used with excellent results.

A ration composed of silage, 60 pounds; oat straw, 10 pounds; ground barley, 5 pounds, corn meal, 3 pounds, and cotton-seed meal, 2 pounds is sometimes used. This ration is fed in three feeds, the silage morning and night, with one-half of the grain ration fed at each feed, and the oat straw for a midday feed. A second ration is composed of beet pulp, 100 pounds; alfalfa, 12 pounds; oat straw, 5 pounds; ground barley, 3 pounds; corn meal, 3 pounds, and cotton-seed meal, 2 pounds.

The most common ration fed on this estate includes both silage and beet pulp and is composed as follows: Beet pulp, 60 pounds; silage, 30 pounds; clover hay, 5 pounds; oat straw, 8 pounds; ground barley, 3 pounds; corn meal, 2 pounds, and cotton-seed cake, 2 pounds. The hay is fed in the early morning, the beet pulp and half of the grain ration about 8 o'clock in the morning, the oat straw at noon, and the silage and the remainder of the grain ration at night.

Ration for steers fed in northern France.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beet pulp	60	6.120	0.360	4.380	.....	.....
Alfalfa and clover silage	30	8.400	.750	3.000	0.450	.....
Clover hay	5	4.235	.340	1.790	.085	.....
Oat straw	8	7.264	.096	3.088	.064	.....
Ground barley	3	2.673	.261	1.968	.048	.....
Corn meal	2	1.782	.158	1.324	.086	.....
Cotton-seed cake	2	1.836	.744	.338	.244	.....
	.....	32.310	2.709	15.898	.977	1:6.68

Farm No. 2.—This farm is located in the east central portion of France. The ration used is simple and contains a large amount of home-grown feeds. The roughage consists of clover hay, 16 pounds; oat straw, 6 pounds; fodder beets, 30 pounds; corn meal, 3 pounds; ground barley, 2 pounds; dried brewers' grains, 3 pounds, and linseed cake, 2 pounds. The hay is fed in two feeds, morning and night, the straw at noon, the roots in the evening, and the grain morning and evening.

Ration for steers fed in east central France.

Feeding stuffs.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	16	13.552	1.088	5.724	0.272	
Oat straw	6	5.448	.072	2.316	.048	
Fodder beets	30	2.730	.330	1.020	.030	
Corn meal	3	2.673	.237	2.001	.129	
Ground barley	2	1.782	.174	1.312	.062	
Dried brewers' grains	3	2.754	.471	1.083	.153	
Linseed cake	2	1.816	.586	.654	.140	
		30.755	2.958	14.710	.804	1:5.58

FEEDING METHODS IN AUSTRIA-HUNGARY.

BREEDING CATTLE.

Where land is rough and is used almost solely for grazing the methods of feeding breeding animals in this country are rather primitive. Grass supplies the feed during the summer and roughage the winter ration. In these districts cattle are kept almost entirely for beef and the calves are generally allowed to suckle their dams.

In the more fertile and densely settled districts, where land is very valuable, cattle are stabled practically all of the time, but this practice is considered detrimental for breeding stock, and the most valuable breeding cows and all young cattle intended for breeding purposes are given as much outdoor exercise as possible. Permanent pastures are very rare, and therefore these animals are usually grazed on the grass lots, on grain fields after the removal of the crop, or on forage crops. They are also soiled on alfalfa, clover, corn, or a combination of cereals, and have a small allowance of crushed oats, corn, and wheat bran. Large amounts of beet pulp are fed in all parts of the country. The young animals are well fed from birth until maturity. From weaning until maturity they are grazed and yard fed during the summer and fed on alfalfa or clover hay with some corn, oats, and bran, and sometimes linseed cake, during the winter. On one of the best farms inspected in the vicinity of Vienna the calves during the first winter after weaning are fed from 6 to 12 pounds of alfalfa, according to size and age, and from 3 to 6 pounds of a grain mixture consisting of two parts shelled corn, one of oats, one of bran, and one of linseed cake per head per day. The yearlings are fed from 10 to 16 pounds of alfalfa and 3 pounds of a grain mixture of two parts corn to one of bran by weight. On other farms somewhat similar winter rations are used. In some instances more grain is fed, especially when other roughage than alfalfa is used; in some instances no grain at all is given.

FATTENING CATTLE.

Cattle are fed and finished for market at all seasons of the year. On account of the large number which are fattened on grass alone and marketed during the summer and fall, an oversupply is likely to occur at that season of the year, and many feeders prefer late fall and winter feeding. Home-grown feeds are used as far as possible, and the use of commercial feeding stuffs is limited and resorted to only when their addition will render possible the use of some home-grown product which would otherwise be rejected. Younger animals are fed more frequently than mature cows or bullocks. It is quite a common practice to feed the latter animals but twice per day.

The following rations represent those fed on the best farms:

Farm No. 1.—Alfalfa, 16 pounds; oat straw, 5 pounds; corn meal, 6 pounds; crushed oats, 4 pounds. The alfalfa is fed in two feeds—morning and evening, the straw at noon, and the grain in two equal feeds—morning and evening. The animals make good growth on this ration and take on flesh rapidly. All of the feeds used are grown on the farm.

Ration for steers fed in Austria-Hungary (farm No. 1).

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Alfalfa hay	16	14.656	1.760	6.336	0.192	.....
Oat straw	5	4.540	.060	1.930	.040	.....
Corn meal	6	5.346	.474	4.002	.258	.....
Crushed oats	4	3.560	.368	1.892	.168	.....
	.....	28.102	2.662	14.160	.658	1:5.87

Farm No. 2.—Corn fodder, 20 pounds; clover hay, 10 pounds; corn meal, 5 pounds; ground barley, 4 pounds; linseed cake, 2 pounds. The corn fodder is fed in the morning, the grain in one feed at 4 o'clock in the afternoon, and the clover hay in the evening. This ration is used in the feeding of grass-grown cattle with fairly good results. All feed except the cake is home grown.

Ration for steers fed in Austria-Hungary (farm No. 2).

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Corn fodder	20	11.560	0.500	6.920	0.240	.....
Clover hay	10	8.470	.680	3.580	.170	.....
Corn meal	5	4.455	.395	3.335	.215	.....
Ground barley	4	3.564	.348	2.624	.064	.....
Linseed cake	2	1.816	.586	.654	.140	.....
	.....	29.865	2.509	17.113	.829	1:7.56

Farm No. 3.—Sugar-beet pulp, 90 pounds; alfalfa hay, 16 pounds; corn meal, 5 pounds. This ration is used in the feeding of mature cattle and gives excellent results. On the same farm the owner previously experimented with beet pulp to determine the proper amounts to feed and the most satisfactory adjuncts to use in connection with it, his object being to use as much of the pulp as possible. After giving various rations a fair test he adopted the one above mentioned. When larger amounts of pulp are fed it has a pronounced and objectionable laxative effect. The alfalfa is fed to supply the protein lacking in the beet pulp, and the corn meal to give a firmer finish and for its favorable influence in counteracting the laxative effect of the rest of the feed used.

Ration for steers fed in Austria-Hungary (farm No. 3).

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beet pulp	90	9.180	0.540	6.570	.....	.....
Alfalfa hay	16	14.656	1.760	6.336	0.192	.....
Corn meal	5	4.455	.395	3.335	.215	.....
.....	.....	28.291	2.695	16.241	.407	1:6.37

GERMAN FEEDING METHODS.

BREEDING CATTLE.

In northern Germany, and to some extent in the western part, all breeding animals are grazed during the summer and early fall. Where stable or yard feeding is practiced during the summer a variety of soiling crops is supplied. These consist of green rye in the early spring, followed by clover or alfalfa in those districts where they can be grown to advantage, then various mixtures of cereals, such as oats and barley, peas, oats, and barley, followed by lupines, green corn, alfalfa, etc.; it is the exception for concentrated feed to be fed in addition. Cattle are usually fed three times per day.

The winter rations vary according to the age of the animal and the supply of feed available. For young animals clover and alfalfa are most generally used for roughage, and in addition a small grain allowance is usually given. Older animals are given a moderate allowance of roughage. When fed largely on clover or alfalfa they receive little concentrated feed, but when the roughage consists largely of poor hay or straw a small allowance of cake is usually given in addition. All animals, bulls in particular, are maintained in a thrifty condition without the slightest tendency toward obesity. Bulls are often used for labor as well as for breeding.

FATTENING CATTLE.

Cattle are fed for beef throughout the entire country. In the grazing districts they are nearly always finished on grass and marketed during the summer and fall. Some farmers use cake (especially cotton cake) in addition to grass, but the practice is by no means general. In the farming districts cattle are soiled and fed on the by-products of sugar factories and breweries. Rather long feeding periods are customary, with low-pressure feeding and the use of rather large amounts of roughage and proportionally small amounts of concentrated feeds. Beef production, as seen on the best British or American farms, does not exist in Germany. However, where beet pulp or wet brewers' grains are used, heavy feeding and rapid gains are the rule.

In some parts of Germany, especially the southern and eastern portions, cattle are often used for labor for a few years and are then fattened for market. Cow beef and 2-year-old or 3-year-old bulls are very conspicuous on nearly all of the leading markets, and really prime beef is the exception. Although this may be due in part to the absence of distinct beef breeds of cattle, the methods of German cattlemen are very different from those of British and American feeders. A very large number of calves are marketed as veal at from six to twelve weeks of age; some of these calves suckle the dams, but the majority are hand fed on skim milk and grain. When cattle are fattened during the summer on the cultivated farms and soiled the majority of farmers prefer having the soiling crops well advanced toward maturity before using them. In addition to the green crops, from 6 to 10 pounds of concentrated feed are usually given. A ration of corn meal and cotton-seed cake in equal parts is very highly favored. The fall and winter rations vary according to the availability of roughage and sugar-factory or brewery by-products.

The following rations are representative and convey a fair idea of German fattening rations:

Farm No. 1.—Clover hay, 10 pounds; oat straw, 6 pounds; wet brewers' grains, 50 pounds, and corn meal, 4 pounds.

Ration for steers fed in Germany (farm No. 1).

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds*	
Clover hay	10	8.470	0.680	3.580	0.170	.....
Oat straw	6	5.448	.072	2.316	.048	.....
Wet brewers' grains	50	12.150	1.950	4.650	.700	.....
Corn meal	4	3.564	.316	2.668	.172	.....
	.....	29.632	3.018	13.214	1.090	1:5.19

Farm No. 2.—Alfalfa, 15 pounds; beet pulp, 100 pounds; corn meal, 3 pounds, and linseed cake, 3 pounds.

Ration for steers fed in Germany (farm No. 2).

Feeding stuff.	Quantity.	Dry matter	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Alfalfa hay	15	13.740	1.650	5.940	0.180	
Beet pulp	100	10.200	.600	7.300	.000	
Corn meal	3	2.673	.237	2.001	.129	
Linseed cake	3	2.724	.879	.981	.210	
		29.337	3.366	16.222	.519	1:5.17

Farm No. 3.—Clover hay, 10 pounds; oat straw, 10 pounds; sugar beets, 20 pounds; dried brewers' grains, 5 pounds, and cotton-seed cake, 5 pounds.

Ration for steers fed in Germany (farm No. 3).

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	10	8.470	0.680	3.580	0.170	
Oat straw	10	9.080	.120	3.860	.080	
Sugar beets	20	2.700	.220	2.040	.020	
Dried brewers' grains	5	4.590	.785	1.815	.255	
Cotton-seed cake	5	4.590	1.860	.845	.610	
		29.430	3.665	12.140	1.135	1:4.01

In many instances German feeders have used much larger quantities of beet pulp and wet brewers' grains than were fed in these rations, but the majority believe that the best results are obtained when from 60 to 100 pounds of beet pulp or about 50 pounds of wet brewers' grains are fed per animal per day with other kinds of feed. The brewers' grains are somewhat too rich in protein for good results, and by the addition of other feeding stuffs a much better balanced ration is obtained.

DAIRY CATTLE.

DAIRY METHODS IN GREAT BRITAIN AND IRELAND.

England.

Cattle of the dairy breeds in England appear to be quite well fed. Guernseys and Jerseys, for example, are kept in much better condition than in their native islands. Young animals are usually better developed at the same age and mature ones are larger, and breeders do not seem to object seriously to flesh, especially on young stock.

FEEDING BREEDING STOCK.

Bull calves are raised in the usual manner by pail feeding, having whole milk for three or four weeks, and after that skim milk, roots, and hay, or skim milk, grain, and cake. Rations of equal parts whole milk and skim milk are fed on some farms. One very successful breeder feeds 6-months-old bulls on a ration of skim milk 20 pounds, flaxseed meal one-half pound (boiled and added to the milk), clover hay 5 pounds, sliced mangels 10 pounds, crushed oats 2 pounds, bran 1 pound, and linseed cake 1 pound.

Heifer calves are not fed so much grain and cake as bulls. They are bred from 15 months to 2 years of age.

Breeding bulls are maintained in low condition, and grain and cake are usually fed only to young bulls or mature ones doing heavy service. Feeds like corn meal, pea meal, bean meal, and ground barley are used sparingly and in conjunction with cooling feeds like roots and green forage. A great deal of exercise is given.

FEEDING DAIRY COWS.

The production of milk generally forms an important part of English farming operations, and dual-purpose cows are usually kept. The blood of the milking Shorthorn prevails in practically all parts of the country, and the special-purpose dairy breeds are more largely found on the estates of the wealthy classes and the nobility than on the farms of the small tenant farmers. The market value of the cows at the end of the milking period and the demand for calves from such cows for feeding exert an important influence in popularizing

the cows of the dual-purpose type. This condition of affairs, in a measure, has an influence on methods of feeding. As milk is not the only source of revenue for which cows are maintained, methods of feeding have not always received as close study from such farmers as is given the subject when dairy farming is conducted as a specialty. Mangels, carrots, white, yellow, and swede turnips, and cabbage are fed. Turnips are given in large quantities either before or after milking. In some private dairies, especially on large estates, which are run principally to supply the landlords' households, care is used to select feed which will not impart undesirable flavors to the milk, but in a large number of commercial dairies this discrimination is not exercised.

All feeders feed at least three times daily and many give six or seven feeds.

A few representative rations fed to milch cows in England are given below:

Farm No. 1.—This farm is located in Berkshire and is stocked with high-class Jersey cows, the milk from which is used to supply a fancy butter, cream, and milk trade. The rations fed are said by prominent dairymen to be the best in England.

During the summer each cow is fed daily, in addition to grass, 2 pounds of undecorticated cotton-seed cake, 3 pounds of wheat bran, and 8 pounds of clover hay. The daily winter ration is composed of 3 pounds crushed oats, 4 pounds wheat bran, 2 pounds cotton-seed cake, 2 pounds bean meal, 15 pounds mangels, 10 pounds cut hay, and 8 pounds long hay per head. The grain and cake are mixed with the cut hay, scalded, and fed in two feeds—one in early morning and the other in late afternoon; the roots are fed after milking in the morning and the long hay is fed after milking in the evening.

Ration for dairy cows fed in Berkshire, England.

Feeding stuff.	Quantity.	Dry matter	Digestible protein.	Digestible carbohydrates.	Digestible fat	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	18	15.678	1.062	7.392	0.216	
Mangels	15	1.365	.165	.810	.015	
Bran	4	3.524	.488	1.568	.108	
Crushed oats	3	2.670	.276	1.419	.126	
Cotton-seed cake	2	1.836	.744	.338	.241	
Bean meal	2	1.714	.448	.986	.024	
		26.787	3.183	12.483	.733	1:4.44

Farm No. 2.—This farm is located in Cheshire, and is stocked with purebred milking Shorthorns. During the summer months each cow in full milk receives, in addition to grass, a daily grain mixture

composed of 2 pounds dried brewers' grains, 1 pound bran, 2 pounds undecorticated cotton-seed cake, and 1 pound of linseed cake. The fall and winter rations are composed of mixed hay, 15 pounds; oat straw, 7 pounds; swedes, 60 pounds; wet brewers' grains, 10 pounds; cotton-seed cake, 3 pounds; corn meal, 5 pounds, and wheat bran, 4 pounds. The cows receive both morning and evening a mixture of cut hay, pulped swedes, wet brewers' grains, and some bran, amounting in all to about 15 pounds at each feed, in the form of a scalded mash. The remainder of the swedes is fed in two feeds of about 25 pounds each, morning and evening. The straw is given at the last feed at night. The corn meal and cotton cake are mixed and fed in two equal feeds, morning and evening. About 8 pounds of long hay is fed as a midday feed, the remainder being cut and fed in conjunction with bran, swedes, and wet brewers' grains. From the standpoint of both milk production and the maintenance of a healthy condition of the cows the ration was satisfactory.

Ration for dairy cows fed in Cheshire, England.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	15	13.065	0.885	6.135	0.180	.....
Oat straw	7	6.356	.084	2.702	.056	.....
Swedes	60	6.000	.600	4.800	.120	.....
Wet brewers' grains	10	2.430	.390	.930	.140	.....
Cotton-seed cake	3	2.754	1.116	.507	.366	.....
Corn meal	5	4.455	.395	3.335	.215	.....
Wheat bran	4	3.524	.488	1.568	.108	.....
	.....	38.584	3.958	19.977	1.185	1 : 5.73

Farm No. 3.—This farm is located in the county of Cumberland and carries a herd of 40 high-grade Shorthorn dairy cows. During the summer months no other feed than pasture is furnished. The winter ration is different from that seen on any other farm visited, and produces a good flow of milk. All of the feeding stuffs, with the exception of the cake, are grown on the farm. The daily feeding per head is as follows: At 5 a. m., 4 pounds cut sheaf oats, 7 pounds pulped swedes, 1½ pounds cotton-seed cake, and 1½ pounds linseed cake, all mixed together before feeding; 7 a. m., 14 pounds of whole swedes and 7 pounds of long mixed hay; 9 a. m., 7 pounds of the same mixture which was fed at 5 a. m.; 10 a. m., 7 pounds long hay; 12 m., 3½ pounds long hay; 2.30 p. m., same as at 5 a. m.; 4 p. m., 14 pounds whole swedes; 7 p. m., 7 pounds of cabbage and 7 pounds long hay. The cows are watered twice a day, at 8 a. m. and 3 p. m.

Ration for dairy cows fed in Cumberland, England.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	24.5	21.340	1.446	10.021	0.294	
Swedes	45.5	4.550	.455	3.640	.030	
Sheaf oats	10	9.110	.430	4.640	.150	
Cotton-seed cake	3.75	3.443	1.395	.631	.458	
Linseed cake	3.75	3.405	1.069	1.226	.263	
Cabbage	7	1.071	.126	.574	.028	
		42.919	4.951	20.735	1.283	1 : 4.77

Farm No. 4.—This farm is located in Norfolk and is stocked with one of the largest herds of Red Polled cows to be found in England. During the summer months all cows which have not been in milk seven months are fed a mixture of undecorticated cotton cake and linseed cake, in addition to the grass. The amount fed varies from 3 to 5 pounds per cow per day. The winter rations are composed of mixed hay, roots, and a grain mixture of crushed oats, wheat bran, linseed cake, and cotton cake. While some turnips are fed during the fall months, mangels are relied upon very largely to furnish succulent feed during the winter. The ration fed in January to cows in full milk was composed of mixed hay, 20 pounds (10 pounds of which was cut and mixed with pulped mangels and grain); mangels, 60 pounds; crushed oats, 3 pounds; bran, 3 pounds; linseed cake, 3 pounds, and cotton-seed cake, 3 pounds. The cows were fed a mixture of cut hay, pulped mangels, and half of the grain and cake in the early morning and before milking in the evening. The long hay was fed at noon and night, while the roots were fed at 8 a. m. and 3 p. m.

Ration for dairy cows fed in Norfolk, England.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	20	17.420	1.180	8.180	0.240	
Mangels	60	5.460	.660	3.240	.060	
Crushed oats	3	2.670	.276	1.419	.126	
Wheat bran	3	2.643	.396	1.176	.081	
Linseed cake	3	2.724	.879	.981	.210	
Cotton-seed cake	3	2.754	1.116	.507	.306	
		33.671	4.477	15.503	1.083	1 : 4.00

SCOTLAND.

FEEDING BREEDING ANIMALS.

The breeding of dairy cattle is confined almost solely to the southwest of Scotland, where the Ayrshire breed is maintained. As the

land surface is rather rough and broken the conditions are not favorable for roots or grain crops. The cattle are grazed during the summer and maintained largely on hay and grain during the winter. Straw is fed, but not to the same extent as in the grain-growing districts. Roots are fed by some farmers, but their use is limited when compared with the methods prevailing in central and northern Scotland. The aim of breeders throughout the entire district is to maintain their animals as economically as possible. While they are warmly housed during the coldest months, the grazing season is much longer than that of the more highly arable sections of the country. Calves are raised in the usual way, having whole milk for two or three weeks, and then milk or sweet whey and grain until they are 6 to 10 months old. Bulls and heifer calves are fed the same way until they are 12 months of age, after which the bulls are confined and fed more grain and cake than the heifers, the latter being on pasture as much as possible.

On the farm of one of the most successful breeders of Ayrshire cattle the calves are fed during the winter on timothy hay, roots, and a grain mixture composed of equal parts crushed oats, wheat bran, and linseed cake. At the time of the writer's visit in January the calves, ranging in age from 9 to 13 months, were eating on an average 10 pounds of hay, 15 pounds of turnips, and 4 pounds of the grain and cake mixture per day. On other farms no roots are fed and oat straw is given as part of the roughage. The breeding bulls are not maintained in very high condition. Their winter rations are composed of roughage, grain and roots when they are grown. During the summer a great deal of green feed is fed.

FEEDING DAIRY COWS.

Scotch farmers do not patronize creameries and cheese factories, butter and cheese being made on the farms where the milk is produced. The men who furnish milk to the city dealers do not as a rule milk a cow more than ten or twelve months. They are continually buying fresh milking cows, largely of Shorthorn breeding, from the northern counties of England, and are selling out of their stables for beef cows which have been very heavily fed throughout the entire milking period and for the succeeding four or five months. Young cows which have dropped their second or third calves are used, as they milk well, fatten readily, and return the greatest profits for the feed consumed.

Dairymen who retain their cows for several years do not feed so heavily. The cows are fairly well fed during the first five months of lactation, and the amount of grain and cake is then reduced or omitted entirely. They believe that this method of feeding gives

the cow a chance to rest, and her period of usefulness as a breeder and milker is therefore very much longer than when heavily fed on grain and cake.

In the dairies from which the city milk trade is supplied feeders use large quantities of turnips and swedes—as much as 100 pounds per cow being fed daily—and no precautions are taken in regard to the time of feeding them. The stables are hot, without any provision for ventilation. These methods do not prevail on farms where butter and cheese are manufactured. Here a great deal of care is exercised to avoid injuring the flavor or texture of the finished product by improper feeding. Some dairymen cut a great deal of the hay and straw and mix all the grain and cake with it, and either steam or scald it before feeding. On other farms part of the roughage is cut, mixed with pulped turnips, grain, and cake, and allowed to stand twelve or fifteen hours before being fed. The cows are fed from four to nine times per day.

The following rations are fairly representative:

Farm No. 1.—This farm is located within 2 miles of Edinburgh, and the methods of feeding are representative of those practiced by the men who feed their cows heavily for about ten or twelve months and then sell them to the butcher. The herd contained 56 cows, nearly all of which were English-bred Shorthorns from Cumberland. The winter ration for cows in full milk was composed of 100 pounds of turnips, fed in three feeds—morning, noon, and night; 70 pounds of wet brewers' grains, 5 pounds of pea meal, and 10 pounds of oat straw. The pea meal was fed with the wet brewers' grains, which were given in two feeds, one in the early morning and the other about 5 p. m. The oat straw was fed at night.

Ration for dairy cows fed near Edinburgh, Scotland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Turnips	100	9.500	1.000	7.200	0.200	
Wet brewers' grains	70	17.010	2.730	6.510	.980	
Oat straw	10	9.080	.120	3.860	.080	
Pea meal	5	4.475	.840	2.590	.035	
		10.065	4.690	20.160	1.295	1 : 4.92

Farm No. 2.—This farm is located in the county of Ayr, and on it is maintained a herd of 70 cows. The milk is used for cheese making. During the summer the cows receive a grain mixture of 2 pounds bean meal, 2 pounds wheat bran, and 1 pound crushed oats. The winter ration is composed of timothy hay, 15 pounds; oat chaff, 5 pounds; crushed oats, 3 pounds; wheat bran, 3 pounds; linseed cake, 2 pounds, and bean meal, 4 pounds. The hay is fed in three feeds—

morning, noon, and night; the grain is mixed with the oat chaff and fed in two feeds—morning and evening.

Ration for dairy cows fed in Ayrshire, Scotland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Timothy hay	15	13.020	0.420	6.510	0.210	.....
Oat chaff	5	4.285	.075	1.650	.035	.....
Crushed oats	3	2.670	.276	1.419	.126	.....
Wheat bran	3	2.643	.366	1.176	.081	.....
Linseed cake	2	1.816	.586	.654	.140	.....
Bean meal	4	3.428	.896	1.972	.048	.....
	.....	27.862	2.619	13.381	.640	1:5.16

Farm No. 3.—This farm is located in Perthshire, near the city of Perth. The milk supplies the city trade. The herd contains 40 cows, and instead of selling them off at the end of the milking period the owner breeds them to a good purebred Aberdeen-Angus bull, and the calves when dropped are eagerly sought for at good prices by cattle feeders, who rear them on nurse cows.

The winter ration is oat straw, 12 pounds; turnips, 100 pounds; wet brewers' grains, 20 pounds; linseed cake, 2 pounds; ground barley, 3 pounds; wheat bran, 4 pounds, and bean meal, 3 pounds. The straw is fed in two feeds, the turnips in three feeds, and the wet brewers' grains and the grain and cake mixed in two equal feeds.

Ration for dairy cows fed in Perthshire, Scotland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Turnips	100	9.500	1.000	7.200	0.200	.....
Wet brewers' grains	20	4.860	.780	1.860	.280	.....
Oat straw	12	10.896	.144	4.632	.096	.....
Linseed cake	2	1.816	.586	.654	.140	.....
Ground barley	3	2.673	.261	1.968	.048	.....
Wheat bran	4	3.524	.488	1.568	.108	.....
Bean meal	3	2.571	.672	1.479	.036	.....
	.....	35.840	3.931	19.361	.908	1:5.44

Farm No. 4.—This farm is located in the county of Lanark and maintains a herd of 25 cows. Butter making is its specialty. During the summer the cows are fed equal parts of crushed oats, wheat bran, and dried brewers' grains, in addition to grass. The amount varies from 4 to 7 pounds per cow per day, according to the condition of the pastures. The winter ration includes 20 pounds of mixed hay, 20 pounds of turnips, 3 pounds bean meal, 2 pounds pea meal, 3 pounds wheat bran, and 3 pounds of ground barley. The turnips are

fed immediately after milking in the morning and before the cows are let out in the fresh air for exercise.

Ration for dairy cows fed in Lanarkshire, Scotland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	20	17.420	1.180	8.180	0.240	
Turnips	20	1.900	.200	1.440	.040	
Bean meal	3	2.571	.672	1.479	.036	
Pea meal	2	1.790	.336	1.036	.014	
Wheat bran	3	2.643	.366	1.176	.081	
Ground barley	3	2.673	.261	1.968	.048	
		28.997	3.015	15.279	.459	1:5.41

IRELAND.

The dairy industry is of great importance in Ireland. Although all Irish farmers are more or less engaged in milk production, those of the south of Ireland devote practically all of their attention to dairying. The cows drop their calves in the early spring and are milked until late in the fall, as long as the grass lasts, and are then dried off. During the winter they are fed on rather scanty rations, such as oat straw, the run of a grass lot, and occasionally some hay. On some farms the cows are comfortably housed during the winter and well fed. In the central and northern districts cows are given much better care and feed during the winter. Grass is the staple feed in summer in all parts of the country. In the province of Ulster, especially in County Down, some dairy farmers feed a small allowance of cotton cake in addition to grass.

The following rations illustrate the methods on the best farms in central and northern Ireland:

Farm No. 1.—This farm is in county Kildare, near the city of Dublin, and the milk supplies the city trade. Ration: Mixed hay, 10 pounds; clover hay, 10 pounds; mangels, 30 pounds; crushed oats, 3 pounds; ground barley, 3 pounds; linseed cake, 2 pounds.

Ration for dairy cows fed in County Kildare, Ireland.

Feeding stuff.	Quantity.	Dry matter	Digestible protein.	Digestible carbohydrates	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	10	8.710	0.590	4.090	0.120	
Clover hay	10	8.470	.680	3.580	.170	
Mangels	30	2.730	.330	1.620	.030	
Crushed oats	3	2.670	.276	1.419	.126	
Ground barley	3	2.673	.261	1.968	.048	
Linseed cake	2	1.816	.586	.654	.140	
		27.069	2.723	13.331	.634	1:5.4

Farm No. 2.—This farm is located in County Antrim, in the province of Ulster. The milk supplies a city trade. The herd consists of 40 high-grade Shorthorns. Ration: Mixed hay, 20 pounds; turnips, 30 pounds; crushed oats, 3 pounds; corn meal, 3 pounds; wheat bran, 2 pounds, and cotton-seed cake, 2 pounds.

Ration for dairy cows fed in County Antrim, Ireland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	20	17.420	1.180	8.180	0.240	
Turnips	30	2.850	.300	2.160	.060	
Crushed oats	3	2.670	.276	1.419	.126	
Corn meal	3	2.673	.237	2.001	.129	
Wheat bran	2	1.762	.244	.784	.054	
Cotton-seed cake	2	1.836	.744	.338	.244	
		29.211	2.981	14.882	.853	1:5.64

Farm No. 3.—This is a large farm in County Down, province of Ulster. Ration: Clover hay, 15 pounds; oat straw, 6 pounds; ground barley, 5 pounds; wheat bran, 2 pounds, and linseed cake, 3 pounds. The grain is scalded with hot water and fed in two feeds. The hay is given night and morning and the straw at noon.

Ration for dairy cows fed in County Down, Ireland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	15	12.705	1.020	5.370	0.255	
Oat straw	6	5.448	.072	2.316	.048	
Ground barley	5	4.455	.435	3.280	.080	
Wheat bran	2	1.762	.244	.784	.054	
Linseed cake	3	2.724	.879	.981	.210	
		27.094	2.650	12.731	.647	1:5.35

DAIRY FARMING IN DENMARK.

Denmark is preeminently a dairy country and the cattle interests are all centered on the production of milk. More than a quarter of a century ago beef production was extensively carried on, but it is now a thing of the past. Keen competition in the world's markets, due to improved transportation facilities, drove the Danish farmer out of the beef business and caused him to devote his attention to dairying. This change has had a wonderful influence on the type of cattle bred within the country. The two native breeds, the Red Danish and the Jysk (or Jutland breed), both of which were formerly used for beef, have been so markedly changed by a judicious system of breeding, feeding, and selection that they now rank among the foremost breeds of dairy cattle. The aim and purpose of the farmers in

all parts of Denmark is to keep the greatest number of high-class dairy cows possible on a given area of ground. When we take into consideration the light nature of the soil, its northern location, and the more limited scope of vegetation, we must admit that the farmers of Denmark, as a whole, have advanced and developed dairy farming in a measure that is certainly not equaled or even approached by that of any other country. At the present time the average Danish farmer maintains about one cow for every two and a third acres of land in his farm, and in addition grows enough young cattle to replace any cows which are discarded from time to time on account of age or accident. All calves, except those from the best cows and intended for breeding purposes, are sold for veal when but a few weeks old.

It is the prevailing custom to stable the cows about eight months out of each year and green forage is fed during the remaining four months. Although about one-seventh of each farm is devoted to grass, cattle are seldom allowed free access to it. In some instances this grass is cut and fed to the cows in stables or open paddocks. The most prevalent practice, however, is to tether them in rows and allow them a new feeding ground each day. This allows each strip of land several days' rest, and much more feed is obtained from a given area of ground than would otherwise be possible.

The cows receive green forage or concentrated feed, or both. The grass lot is also useful to afford a means of supplying exercise and fresh air, and some farmers, who do not set aside land for grazing, have open paddocks adjoining the stables, where the cows spend several hours each day.

A great deal of attention is given to the study of feeding, and very accurate records are kept of the amount of feed consumed and the milk and butter fat produced. By means of these records the inferior cows can be weeded out of a herd and the average yield increased. To aid the small farmers in this work the Royal Danish Society has established a system of "Kontrol" societies all over the country. The system is as follows: The farmers of a district form a cooperative society for the purpose of securing a "Kontrol" inspector from the Royal Danish Society to take charge. Before such an inspector will be appointed there must be about 1,000 cows represented by the local membership. To defray part of the expenses of the work each member is assessed a small amount, which varies in different societies from 26 cents to 53 cents per cow, according to the number of cows and the character of the work to be done. The "Kontrol" inspector makes an inspection of each farm about once every eighteen days, and keeps a set of books with each farm in duplicate, one set being retained by the farmer. Among other things,

he records the total amount of milk produced by each cow since his last visit (the milk being regularly weighed and entered in a special book by the farmer); the percentage of fat contained in the daily samples of the milk; a calculation of the butter produced; the amount of feed eaten per cow; the amount of butter produced in relation to the amount of feed consumed; the total amount of milk per cow per annum, its cost, and the net profit per cow. He advises concerning the selection of bulls for the different cows, the kinds of crops to grow, and any changes which would be beneficial in the rations, and recommends the disposal of all cows which have not returned a profit on the feed consumed. This system has done a great deal of good and its cost is very small. With some societies the average annual yield of milk per cow has increased 1,000 pounds in less than four years from the time they were first started. This increase has been due largely to better methods of feeding and more careful selection of the cows in the herd.

The Danish farmers fully appreciate the advantages of this system and hope for still greater improvements. Every precaution is taken which will in any way have a favorable influence on the yield of milk. The stables are well ventilated, so that their winter temperature is about 60° F. On many farms the cows are groomed twice or three times weekly.

BREEDING CATTLE.

Under this head only the methods of feeding young cattle and breeding bulls will be considered. All breeding cows are kept for milk production and are fed for that purpose; methods of feeding them will be discussed in that connection.

Much care is given to the feeding of breeding bulls, and the Danish farmers aim to retain all sires which get good stock until they are 10 or 12 years of age or as long as they prove sure stock getters. Under the Danish system a bull is not eligible to registration until he is at least 3 years old and has proved himself a useful sire. These people have many sensible ideas regarding the management of their animals. A bull is not purchased or rejected on his general appearance, but the quality and productive powers of his stock determine his value in the market.

The grain part of the ration is usually crushed oats and bran or ground barley and bran. Bulls are not fed cotton-seed, sunflower, or rape-seed cake, but linseed cake is sometimes used. Roots are given during the fall and winter months.

THE FEEDING OF DAIRY COWS.

The feeding of dairy cows is a vital question in Denmark. Everything grown on the farm is utilized to the very best advantage possible and is supplemented by a large amount of imported concentrated feed.

A variety of soiling crops is grown on each farm. The first in season is winter rye, which is ready for cutting in May. Next follow the clovers, then the various cereal crops, such as oats and barley and other mixtures. Vetches, peas, and other forms of leguminous crops are also grown to some extent and are very highly prized. These crops are allowed to reach a fair degree of maturity before being used. Root crops, especially mangels and beets, are very generally grown.

When cows are tethered during the summer they are fed moderate quantities of green forage or concentrated feed, or both, in addition to grass.

The following rations are representative of feed during the summer season:

Farm No. 1.—This is a rather large farm near Bregentved. The cows are tethered for several hours each day on a grass lot. The grain ration consists of 3 to 6 pounds per cow per day of a mixture of 2 parts cotton cake, 1 part ground barley, and 1 part wheat bran. The earliest green feed is winter rye. Later on clover is used, followed by a mixture of oats, barley, and vetches sown at different intervals.

In the early fall roots are used. The amount of fodder fed varies from 30 to 60 pounds per day, according to the condition of the grass lots.

Farm No. 2.—This is a small-sized farm located in the vicinity of Horsens. The cows are grazed on a grass lot for several hours each day and confined to the stables or yards the remainder of the time. The soiling crops are winter rye, clover, mixed grasses, oats and barley, vetches and roots. The forage is fed in the morning and after milking in the evening. In addition, from 2 to 4 pounds of cotton cake are fed each cow daily.

Farm No. 3.—This farm is located near Kolding, in the south of Jutland, and consists of some 18 acres. By using rather large amounts of concentrated feed the owner is able to keep 10 cows. No land is set aside for grazing, the cows being stabled, with the exception of a few hours daily in an open paddock for exercise. For soiling winter rye, clover, mixed grass and clover, peas, oats and barley, and roots are used. The concentrated feed is composed of cotton cake 2 parts, dried brewers' grains 2 parts, and ground barley 1 part, and from 5 to 7 pounds is fed daily in two equal feeds, morning and evening.

During the winter cows are confined practically all of the time in warm stables, and are usually fed three times daily. As a rule, all grain is crushed or ground, but little labor is expended on the preparation of feed.

The following rations illustrate the general methods of winter feeding.

Farm No. 1.—This is a very large farm, near Bregentved, where between 180 and 200 cows are milked. During the winter the cows are confined to the stalls most of the time, and a supply of fresh water is always before them. The roughage is clover or mixed hay, oat or barley straw, the combination in most general use being 12 pounds clover hay and 8 pounds of oat straw. The hay is fed morning and night and the straw at noon. About 20 pounds of mangels are fed each morning and evening. The grain ration is crushed oats 2 pounds, ground barley 2 pounds, cotton-seed cake 2 pounds, and bean meal 2 pounds, fed in two equal feeds, morning and evening.

Ration for dairy cows fed near Bregentved, Denmark.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	12	10.164	0.816	4.296	0.204	.....
Oat straw	8	7.264	.096	3.088	.064	.....
Mangels	40	3.640	.440	2.160	.040	.....
Crushed oats	2	1.780	.184	.946	.084	.....
Barley meal	2	1.782	.174	1.312	.032	.....
Cotton-seed cake	2	1.836	.744	.338	.244	.....
Bean meal	2	1.714	.448	.986	.024	.....
	.....	28.180	2.902	13.126	.692	1:5.06

Farm No. 2.—This is a large farm near Hasler, and the owner maintains about 100 cows. Complete records are kept of all the feed consumed and milk produced. The stables are very warm, but the cows are out a few hours each fine day in an open court. About 14 pounds of mixed hay, about 6 pounds of barley straw, and 30 pounds of mangels per cow per day are fed. The grain ration consists of ground barley 3 pounds, cotton-seed cake 3 pounds, and wheat bran 2 pounds. The hay is fed morning and night, the straw at noon, the roots in two feeds—late morning and about 5 o'clock in the afternoon—and the grain in two equal feeds, morning and night.

Ration for dairy cows fed near Hasler, Denmark.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	14	12.194	0.826	5.726	0.168	.....
Barley straw	6	5.148	.042	2.472	.036	.....
Ground barley	3	2.673	.261	1.968	.048	.....
Cotton-seed cake	3	2.754	1.116	.507	.336	.....
Wheat bran	2	1.762	.244	.784	.054	.....
Mangels	30	2.730	.330	1.620	.030	.....
	.....	27.261	2.819	13.077	.672	1:5.18

Farm No. 3.—This is a medium-sized farm in the vicinity of Roskilde, and is considered to be fairly representative of the average farm of Denmark. The ration consisted of mixed hay 15 pounds, oat straw 6 pounds, mangels 30 pounds, and a grain mixture of crushed oats 2 pounds, ground barley 2 pounds, dried brewers' grains 2 pounds, and rape-seed meal 2 pounds.

Ration for dairy cows fed near Roskilde, Denmark.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	15	13.065	0.885	6.135	0.180	
Oat straw	6	5.448	.072	2.316	.048	
Mangels	30	2.730	.330	1.620	.030	
Crushed oats	2	1.780	.184	.946	.084	
Ground barley	2	1.782	.174	1.312	.032	
Dried brewers' grains	2	1.836	.314	.726	.102	
Rape-seed meal	2	1.800	.504	.474	.150	
		28.441	2.463	13.529	.626	1:6.06

Farm No. 4.—This is a small farm near Lyngby, where the owner keeps fourteen cows on 30 acres. The stables are warm and well ventilated; water is constantly in front of the cows. Ration: Clover hay, 14 pounds; oat straw, 6 pounds; ground barley, 3 pounds; sunflower-seed cake, 3 pounds; wheat bran, 2 pounds; carrots, 30 pounds.

Ration for dairy cows fed near Lyngby, Denmark.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	14	11.858	0.952	5.012	0.238	
Oat straw	6	5.448	.072	2.316	.048	
Ground barley	3	2.673	.261	1.968	.048	
Sunflower-seed cake	3	2.754	.936	.588	.384	
Wheat bran	2	1.762	.244	.784	.054	
Carrots	30	3.420	.240	2.340	.060	
		27.915	2.705	13.008	.832	1:5.49

While in the city of Copenhagen the writer inspected the methods of the Copenhagen Milk Supply Company, which is owned and operated by people of the city, who contract with farmers. This organization has exacting regulations. No farmer furnishing milk to it is allowed to feed brewers' grains or any distillery refuse. He must not feed turnips, turnip leaves, nor more than 30 pounds per cow per day of either carrots or mangles. Furthermore, no cake, except rape-seed cake, can be used, and the use of that is limited to 1½ pounds per cow per day, and may be fed only when at least 5 pounds of a mixture of oats, barley, and bran are fed with it. Stable

feeding of cows in the summer is not permitted under any circumstances. They must be fed in the open air, in yards, or pastured in a grass lot. The feeding of vetches is also forbidden. In addition to the general trade, there is a special demand for milk for infants. For this purpose the milk from certain farms only is used. All the restrictions which apply to the general trade are enforced on these farms, and in addition the following must be strictly observed: Except of carrots limited to 15 pounds per cow per day, no roots can be fed and no cake can be used under any circumstances. These restrictions increase the cost of production, but this is counterbalanced by the additional compensation, as the prices are very much in advance of those obtained for ordinary milk.

In addition to this company, a similar organization has been recently established by cow owners for the same purpose. On some of the farms which were supplying the general trade the cows, instead of being grazed all the time during the summer season, were fed partially on soiling crops. These crops were fed in open feed lots and not in the stables. On one farm, which was supplying milk for infants, the cows were grazed all the time and milked in the pasture lot. In addition to the grass they received about 4 pounds per cow per day of a mixture of equal parts of crushed oats and wheat bran.

The following winter ration is used on a farm supplying the general milk trade: Mixed hay, 15 pounds; oat straw, 5 pounds; mangels, 30 pounds; crushed oats, 2 pounds; ground barley, 2 pounds; wheat bran, 2 pounds; rape-seed cake, 1½ pounds. The hay is fed in two feeds, morning and night, the straw at noon, the mangels in two feeds, after milking in the morning and before milking in the evening, and the grain in two feeds, at milking time, morning and evening.

Ration for dairy cows supplying the Copenhagen milk trade, Denmark.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	15	13.065	0.885	6.135	0.180	.....
Oat straw	5	4.540	.060	1.930	.040	.....
Crushed oats	2	1.780	.184	.946	.084	.....
Ground barley	2	1.782	.174	1.312	.032	.....
Wheat bran	2	1.762	.244	.784	.054	.....
Rape-seed cake	1½	1.350	.378	.356	.113	.....
Mangels	30	2.730	.330	1.620	.090	.....
	.....	27.009	2.255	13.083	.533	1:6.34

On a farm where milk is produced for infants the following winter ration is in use: Clover hay, 16 pounds; oat straw, 6 pounds; crushed oats, 3 pounds; ground barley, 2 pounds; wheat bran, 5 pounds; carrots, 15 pounds. The feed is fed in the stable, but the cows are

turned out in an open lot for a few hours each day, weather permitting.

Ration for dairy cows supplying milk for infants, Denmark.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	16	13.552	1.088	5.728	0.272	....
Oat straw	6	5.448	.072	2.316	.048	....
Crushed oats	3	2.670	.276	1.419	.126	....
Ground barley	2	1.782	.174	1.312	.062	....
Wheat bran	5	4.405	.610	1.960	.135	....
Carrots	15	1.710	.120	1.170	.090	....
	.....	29.567	2.340	13.905	.643	1:6.57

FEEDING METHODS IN HOLLAND.

Dairying is the most important branch of farming in Holland. The entire country is densely stocked with the native black-and-white cattle which in America are designated as the Holstein-Friesian breed. It is a strictly grazing country and has many natural advantages for live-stock production. The rich soil and moist climate insure an abundance of grass and a plentiful hay crop. Root crops also do unusually well. Of the cereals oats are the most commonly grown, but wheat and barley are both grown in considerable quantities.

BREEDING CATTLE.

The Dutch system of feeding and rearing cattle is simplicity itself. The calves are given whole milk until about 5 weeks old, when the ration is gradually changed to skim milk and grain. The grain is cooked or steamed and fed with the milk at first, but when the calves are old enough the grain is fed dry immediately after giving the milk. When grass is available, it constitutes the entire ration for heifers, and during the winter the rations are only sufficient to keep them growing nicely.

Bulls are fed in the same manner until they are a year old, after which they are rather closely confined. Bulls used for breeding are kept in stables or paddocks. They are well fed, but are not allowed to become fat. Roots in winter and green forage in summer are largely used. Regular exercise is given.

FEEDING DAIRY COWS.

On the majority of the farms during summer the cows gather all their feed from the grass lots, although additional feed may be supplied when the grass supply runs short. Bran, cake, and oats are all used to some extent for this purpose, but the principal feed is the refuse from the gin distilleries, fed in open tubs in the grass lots.

This resembles brewers' grains and is relished by the animals. The amount fed per day varies from 30 to 70 pounds per cow, according to the condition of the grass.

In winter they use various kinds of home-grown roughage, roots, and a considerable amount of concentrated feed. Large quantities of hay and straw are used. The following rations are representative:

Farm No. 1.—This farm is located in the western part of Holland, near Alkmaar, and is considered to be one of the best in that locality. A large herd of very heavy-milking cows are maintained. The winter ration is clover hay, 20 pounds; oat straw, 6 pounds; mangels, 50 pounds; crushed oats, 3 pounds; corn, 3 pounds; wheat bran, 2 pounds; linseed cake, 2 pounds. The hay is fed in two feeds, morning and night, the straw at noon, the mangels in two equal feeds, after milking morning and night, the grain at milking times.

Ration for dairy cows fed in western Holland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	20	16.940	1.360	7.160	0.340	.....
Oat straw	6	5.448	.072	2.316	.048	.....
Mangels	50	4.550	.550	2.700	.050	.....
Crushed oats	3	2.670	.276	1.419	.126	.....
Corn meal	3	2.673	.237	2.001	.129	.....
Wheat bran	2	1.762	.244	.784	.054	.....
Linseed cake	2	1.816	.586	.654	.140	.....
	.....	35.859	3.325	17.034	.887	1:5.72

Farm No. 2.—This farm is located in the northern part of Holland, near the town of Helder. The farm is not large, but is heavily stocked. The winter ration for cows in full milk is as follows: Mixed hay, 25 pounds; mangels, 40 pounds; crushed oats, 3 pounds; dried brewers' grains, 5 pounds; linseed cake, 2 pounds. The hay is fed in three feeds, morning, noon, and night; the roots in two feeds, after milking in the morning and about 5 o'clock in the evening, and the grain in two feeds, at milking time morning and evening.

Ration for dairy cows fed in northern Holland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	25	21.775	1.475	10.225	0.300	.....
Mangels	40	3.640	.440	2.160	.040	.....
Crushed oats	3	2.670	.276	1.419	.126	.....
Dried brewers' grains	5	4.590	.785	1.815	.255	.....
Linseed cake	2	1.816	.586	.654	.140	.....
	.....	34.491	3.562	16.273	.861	1:5.11

Farm No. 3.—This farm is located at Delft, near The Hague, in southwest Holland. The owner maintains a herd of 50 cows to supply the city milk trade. His winter rations are as follows: Clover hay, 15 pounds; mixed hay, 7 pounds; wet distillery grains, 40 pounds; corn meal, 3 pounds; wheat bran, 3 pounds; linseed cake, 2 pounds. The mixed hay is fed in the morning and the clover hay noon and night. The distillery grains are fed after milking morning and evening, and the grain ration at milking time morning and evening. The cows gave a large flow of milk but were in thin flesh at the time of the writer's visit.

Ration for dairy cows fed in southwestern Holland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	15	12.705	1.020	5.370	0.255	
Mixed hay	7	6.097	.413	2.863	.084	
Wet distillery grains	40	9.720	1.560	3.720	.560	
Corn meal	3	2.673	.237	2.001	.129	
Wheat bran	3	2.643	.366	1.176	.081	
Linseed cake	2	1.816	.586	.654	.110	
		35.654	4.182	15.784	1.249	1:4.45

CONDITIONS IN THE CHANNEL ISLANDS.

JERSEY.

That dairy farming can be conducted on very valuable land is amply illustrated on the island of Jersey. With land for agricultural purposes renting for from $40 to $80 per acre the people of this little island have been compelled to adopt a very intensified system of farming. The farms are small and the most important crop is early potatoes, which are grown for export. The live-stock interests are of but secondary importance. Were it not for the fact that animals are needed to aid in the fertilization of the soil and that they are very largely maintained on roots and soiling crops which are grown on the ground after the potatoes are harvested, it is more than likely that no live stock, except those needed for labor, would be maintained. Beef animals are not produced at all; sheep do not number 200 head altogether; horses are bred in very small numbers, the greatest portion of those required for labor being imported; and hogs are to be found on few farms. The Jersey cattle predominate almost to the exclusion of all others, yet they are not kept in sufficient numbers to supply the demands of the people for milk and butter. Butter is imported at all seasons of the year, and especially during the winter months. In former years, when it was the prevailing custom to have the cows calve in the spring of the year, sufficient butter was produced to supply the demand during the summer, but during the winter there was

a great shortage, which was always supplied by other countries. At present, with the cows calving at all seasons of the year, there is enough home-made butter to meet the demands of the higher classes of people, but the lower classes are compelled to use foreign butter throughout the entire year.

FEEDING BREEDING ANIMALS.

Care is used to avoid overfeeding of young animals. The amount of concentrated feed is limited, and much dependence is placed on roughage in winter, grass constituting the sole summer ration. Calves are usually on a ration of whole milk for the first three weeks of life, after which time it is gradually replaced by skim milk, and some farmers raise their calves on grass and skim milk. Others, however, give grain as well. Good results are reported from the use of rice at this time, some farmers feeding nothing but boiled-rice gruel. The best feeders boil 1 quart of rice in 2 gallons of water, which furnishes enough to add to the skim milk for two feeds for four calves of about 4 months old. If the rice has not been previously soaked, it is boiled ten hours, but if soaked for twelve hours it can be boiled sufficiently in one and a half hours. This is a cheap food and costs about 1½ cents per pound.

Both bulls and heifers are fed in much the same way until 15 or 18 months of age, when the bulls are used for service and the heifers are bred. From this time on the heifers are more liberally fed, especially during the last three months of the gestation period.

As the majority of the farms are very small, and but few cows are kept on each farm, individual farmers do not keep bulls exclusively for their own use. The bulls as a rule are owned and maintained by a few of the larger farmers, who receive Government premiums for each bull of merit, provided that the services of such a sire can be had by the smaller farmers at a certain fee, which is always very reasonable. The subsidizing system has been adopted to raise the standard of the cattle on the island and has given very satisfactory results. On several of the farms visited two or three breeding bulls were seen. They are all maintained in very thin flesh. During the winter they are fed hay, roots (turnips, carrots, and mangels), and from 2 to 4 pounds of bran each per day. In the summer they are tethered on grass lots or soiled, with the same allowance of wheat bran. In some instances young bulls are given a small allowance of linseed cake, about 1½ pounds per day, in addition to the bran ration.

FEEDING DAIRY COWS.

The Jersey cow in her native land is not so liberally fed as in other countries. In some instances the cows are wintered on the grass lot

with some straw and a few roots in addition only, but generally they receive better care. Roughage is fed in limited quantities, and a great deal of dependence is placed on the root crops to furnish the bulk of the winter rations. This is a cheap source of feed because they are grown as a second crop on the potato land. Turnips, swedes, carrots, and mangels are all grown. On some farms cabbages are grown for winter feeding. They are not so likely to impart an undesirable flavor to the milk as turnips, and are growing in public favor. Grain and cake are fed in very small quantities. The majority of farmers use from 2 to 5 pounds per cow per day, and it is said that only one farmer on the island feeds as much as 10 pounds to cows in full milk. During the summer no grain is fed as a rule. Great care is given cows at calving time; warm bran mashes are usually fed at this time. Bran mashes are frequently fed throughout the entire period of lactation, and on all farms the cows are grazed from four to seven hours each day throughout the winter. The freedom of the cattle from tuberculosis is emphatic evidence of the wisdom of this method of management.

The following rations are representative of those fed on the best farms, but must be considered as above the general average:

Farm No. 1.—This is a rather large farm in the parish of St. Saviours, where a good herd of milch cows are maintained from which many valuable animals have been exported to America. During the summer months the cows are tethered on a grass lot and receive no additional feed. During the fall, winter, and early spring months they are fed on hay, oat straw, roots, compound cake, wheat bran, and are on grass for six hours each day. They are fed seven times a day—at 5 a. m., 3½ pounds of hay; 7 a. m., 30 pounds of roots; 9 a. m., 2 pounds compound cake and bran; from 10 a. m. to 4 p. m. on grass; 4.30 p. m., 3½ pounds hay; 5.30 p. m., 30 pounds roots; 6.30 p. m., 2 pounds compound cake and bran, and at 8 p. m. 5 pounds of oat straw.

Ration for dairy cows fed in St. Saviours, island of Jersey.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	7	6.097	0.413	2.863	0.084	.....
Turnips	90	5.700	.600	4.320	.120	.....
Straw, oat	5	4.540	.060	1.930	.040	.....
Wheat bran	2	1.762	.244	.784	.054	.....
Compound cake	2	1.816	.540	.610	.170	.....
	.....	19.915	1.857	10.507	.468	1:6.23

Farm No. 2.—This farm is located near St. Helier, and has one of the largest herds on the island. The methods of feeding are said to be much above the average. The summer rations consist of good grass and 2 pounds of cotton cake per cow per day. During the winter all feed is carefully prepared, the hay and straw being cut, the roots pulped, and the bran steamed. The feed is mixed together and allowed to stand for several hours before being fed. At 5 a. m. the cows are fed a mixture of cut hay, bran, and cotton cake, or gluten feed (the latter feed is liked very well, but can not be fed to advantage with large quantities of roots on account of its laxative nature): at 7.30 a. m., cut hay, cut straw, pulped roots, with some bran or crushed oats: at noon, another feed of the same mixture: from 1 p. m. until 5 p. m. they are tethered on a grass lot, and when brought into the stables are given a feed of the same mixture as at 5 a. m.; the last feed of the day is given at 7 p. m., and is the same as that given at 7 a. m. and noon.

Ration for dairy cows fed near St. Helier, island of Jersey.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	8	6.968	0.472	3.272	0.096	.....
Oat straw	4	3.632	.048	1.544	.032	.....
Carrots	40	4.560	.320	3.120	.080	.....
Wheat bran	2	1.762	.244	.784	.054	.....
Crushed oats	2	1.780	.184	.946	.084	.....
Cotton cake	2	1.936	.744	.336	.244	.....
	.....	20.638	2.012	10.002	.590	1:5.63

Farm No. 3.—This farm is located near Granville, and the owner is generally recognized as being the best feeder on the island. The herd numbers about one dozen cows, many of them with records of 17 pounds or more of butter in seven days. The summer ration consists of 3 pounds of cotton cake and good pasture grass for cows in full milk.

The winter ration consists of mixed hay, oat straw, roots (carrots until February and mangels during the remainder of the time), cabbages, compound cake, and wheat bran. At 5 a. m., 4 pounds of hay; 7.30 a. m., 25 pounds carrots; 9 a. m., 20 pounds cabbages; 9.30 a. m., 4 pounds cake and bran; from 10 a. m. until 4 p. m., on pasture; at 4 p. m., 4 pounds of hay; 5 p. m., 25 pounds carrots; 6 p. m., 4 pounds cake and bran; 8 p. m., 5 pounds of oat straw.

Ration for dairy cows fed near Granville, island of Jersey.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	8	6.968	0.472	3.272	0.096	
Oat straw	5	4.540	.060	1.930	.040	
Carrots	50	5.700	.400	3.900	.100	
Cabbages	20	3.060	.360	1.640	.080	
Compound cake	5	4.510	1.350	1.550	.425	
Wheat bran	3	2.643	.366	1.176	.081	
		27.451	3.008	13.468	.822	1:5.09

On several other farms visited the same range of feeding stuffs was used as those mentioned. As a rule, the amounts of grain and cake fed were not so large, while in many instances the amount of roots given was greater.

Guernsey.

Although the island of Guernsey is located quite near the island of Jersey, the conditions prevailing are quite different in many respects. Land rents are not so high in Guernsey, but from the standpoint of live-stock production this has not proved to be an advantage. The live-stock interests are confined almost solely to the Guernsey breed of cattle and are of secondary importance from an agricultural standpoint. The production of tomatoes, grapes, and bulbs, under glass, occupies the first attention of the people, and live stock are maintained largely because of their favorable influence on the fertility of the land. Like the farmers of Jersey, the breeders of Guernsey do not give their cattle as good care and feed as those in countries where the production of dairy and meat products is more important. However, the methods of feeding are very good on many farms. A system of feeding which has a slight tendency to produce flesh is appreciated rather than otherwise. With this exception, however, the methods of feeding are very much the same as in the island of Jersey.

Grass, soiling crops, and roots supply the succulent feed. Mangels, turnips, and carrots are the common roots, but parsnips are also fed and are particularly valuable as they do not taint the milk. The amount of roughage used is larger than in Jersey.

Feeding breeding stock.

Calves are generally fed more liberally than in Jersey. They are usually fed some grain and roots after the whole milk is discontinued. Bulls and heifer calves are fed alike.

Mature bulls are not maintained in high flesh, some breeders believing that high feeding tends to make a bull vicious. During the summer mild-tempered bulls are tethered on grass, but vicious ones are confined to the stables. Additional feed may be given the bulls on grass. During the winter one good breeder feeds his mature bulls on 10 pounds of mixed hay, 5 pounds of oat straw, 60 pounds of roots, and 3 pounds of wheat bran.

FEEDING DAIRY COWS.

The methods of feeding the milch cows are very much the same as those prevailing in Jersey, the chief difference being the larger use of hay and turnips in winter, the use of parsnips, and the greater attention given to the use of soiling crops for spring and early summer feeding. Methods of management are also very similar.

The following are representative winter rations, but on many of the smaller farms more roots and less grain and cake are given:

Farm No. 1.—This is a medium-sized farm near St. Martins on which about a dozen high-class cows are maintained. During the spring and summer the cows are tethered on grass and on such crops as oats and vetches. In addition they receive about 2 pounds of cotton-seed cake and 2 pounds of bran each per day. During the winter they are fed 15 pounds of mixed hay, 50 pounds of roots (parsnips and mangels), and about 8 pounds of bran per cow per day in addition to pasture.

Ration for dairy cows fed near St. Martins, island of Guernsey.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	15	13.065	0.885	6.135	0.180	.....
Parsnips	50	5.850	.800	5.600	.100	.....
Wheat bran	8	7.048	.976	3.136	.216	.....
	.....	25.963	2.661	14.871	.496	1 : 6.01

Farm No. 2.—This is a large farm located near Catel, on which about 60 cows are maintained, including many of the most famous show-yard and butter-test winners at the leading island and English shows.

During the summer the cows receive about 2 pounds of bran and 1 pound of cake each, in addition to grass, those being fitted for exhibition receiving more, in some instances as high as 3 pounds of cake and 5 pounds of warm bran mash. The winter rations consist of about 14 pounds of mixed hay, 3 pounds of oat straw, 3 pounds of cotton-seed cake, 5 pounds of bran in the form of a warm mash,

and 50 pounds of carrots or mangels per cow per day, in addition having several hours each fine day on a grass lot. At the time of the writer's visit the cows were in good condition and giving very satisfactory returns.

Ration for dairy cows fed near Catel, island of Guernsey.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Mixed hay	14	12.194	0.826	5.726	0.168	.....
Oat straw	3	2.724	.096	1.158	.024	...
Mangels	50	4.550	.550	2.700	.050	...
Cotton-seed cake	3	2.754	1.116	.507	.396	...
Wheat bran	5	4.405	.610	1.960	.135	.....
	.....	26.627	3.138	12.051	.743	1:4.37

DAIRY FEEDING IN FRANCE.

French farmers, especially in the northern and central sections, are engaged more or less in milk production, and the feeding of the dairy cow has received considerable attention. While the chief aim is to produce the largest possible flow of milk from a given amount of feed, in some districts much attention is given to the effect of feed on the milk. For instance, some farmers feed cocoanut meal with the hope of improving the flavor and texture of butter.

During summer some of the best farmers graze the cows the entire time, giving no additional feed except in times of continued dry weather or overstocking, when a small allowance of cotton-seed meal or wheat bran may be given, the amount varying from 2 to 6 pounds per cow daily. Some farmers use green forage instead of grain.

Where the land is very valuable and fences are considered wasteful, the cows are fed in a stable and soiled during summer or tethered on grass.

In winter the general tendency is to feed rather heavily on roughage and sparingly on concentrates. As a rule fully two-thirds of the dry matter of the ration is obtained from the roughage.

The following are fairly representative winter rations:

Farm No. 1.—This is a medium-sized farm in Normandy where about 30 cows are milked. The roughage is home-grown; in fact, all of the ration, with the exception of the bran and linseed cake, is produced on the farm. Ration: Alfalfa hay, 22 pounds; ground barley, 3 pounds; crushed oats, 3 pounds; wheat bran, 2 pounds; linseed cake, 1 pound; fodder beets, 20 pounds. The hay is fed in three feeds, morning, noon, and night; the grain in two feeds at milking time, morning and night, and the beets about 4 o'clock in the afternoon.

Ration for dairy cows fed in Normandy, France.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Alfalfa	22	20.152	2.420	8.712	0.264	.....
Fodder beets	20	1.820	.220	1.080	.020	.....
Ground barley	3	2.673	.261	1.968	.048	.....
Crushed oats	3	2.670	.276	1.419	.126	.....
Wheat bran	2	1.762	.244	.784	.054	.....
Linseed cake	1	.908	.293	.327	.070	.....
	.....	29.985	3.714	14.290	.582	1 : 4.19

Farm No. 2.—This is a rather small dairy farm located in French Flanders, a noted dairy district. Although the farm contains but 80 acres, the owner maintains a herd of 30 milch cows in addition to young cattle and other classes of stock. Ration: Clover hay, 12 pounds; oat straw, 6 pounds; dried brewers' grains, 6 pounds; crushed oats, 3 pounds; wheat bran, 2 pounds; cotton-seed cake, 2 pounds. The hay and straw are chaffed. In the evening the hay, straw, and grain to be used the following day are mixed together and moistened. The mixture is allowed to stand overnight, and before feeding the next day is scalded with boiling water. It is fed in three feeds, the largest amount being given at night. However, the preparation of the feed involves a great deal of labor, and the owner frankly admits that he would abandon steaming at least if he had succulent feed.

Ration for dairy cows fed in French Flanders.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	12	10.164	0.816	4.296	0.204	.....
Oat straw	6	5.448	.072	2.316	.048	.....
Dried brewers' grains	6	5.508	.942	2.178	.306	.....
Crushed oats	3	2.670	.276	1.419	.126	.....
Wheat bran	2	1.762	.244	.784	.054	.....
Cotton-seed cake	2	1.836	.744	.338	.244	.....
	.....	27.388	3.094	11.331	.982	1:4.38

Farm No. 3.—This is a medium-sized dairy farm, located in southern Brittany and stocked with an excellent herd of the small black-and-white Brittany cows. The milk is sold to supply a city milk trade, and a uniform flow throughout the winter is desirable.

The following ration is fed: Alfalfa, 15 pounds; mixed hay, 5 pounds; corn meal, 3 pounds; crushed oats, 3 pounds; wheat bran,

2 pounds; and cotton-seed cake, 2 pounds. The grain is fed in two feeds—at milking time morning and evening, the mixed hay at noon, and the alfalfa morning and night.

Ration for dairy cows fed in Brittany, France.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Alfalfa	15	13.740	1.650	5.940	0.180	
Mixed hay	5	4.355	.295	2.045	.090	
Corn meal	3	2.673	.237	2.001	.129	
Crushed oats	3	2.670	.276	1.419	.126	
Wheat bran	2	1.762	.244	.784	.054	
Cotton-seed cake	2	1.836	.744	.338	.244	
		27.036	3.446	12.527	.793	1 : 4.15

DAIRY METHODS IN AUSTRIA-HUNGARY.

Most of the milk used in Austria-Hungary is produced on the farms of the more fertile sections, where farmers keep but a few milch cows and do not follow dairying as a specialty. However, near large cities there are persons who are engaged exclusively in dairy farming. It is not common to graze dairy cows and the practice is limited almost entirely to the hilly districts, where small, productive valleys are surrounded by highland which is only suitable for grazing. When cows are stabled they are soiled during the summer.

Summer rations.—On the majority of farms the summer rations consist of from 50 to 80 pounds of green fodder per cow per day, and from 5 to 10 pounds each of grain.

The following rations will convey a fairly good idea of the methods of summer feeding:

Farm No. 1.—Alfalfa, 60 pounds; corn, 3 pounds; crushed oats, 3 pounds; wheat bran, 2 pounds.

Farm No. 2.—Green corn, 30 pounds; green clover, 20 pounds; green oats, 20 pounds; corn meal, 3 pounds; mill feed, 2 pounds, and wheat bran, 2 pounds.

Farm No. 3.—Alfalfa, 70 pounds, fed in three feeds—two of 20 and one of 30 pounds. The owner had previously been feeding some grain, but, deciding it was not profitable, stopped the grain and increased the alfalfa. According to his statement his cows give just as much milk on alfalfa alone as when fed alfalfa and grain, and the daily ration is about 4½ cents per cow cheaper.

Winter rations.—During the winter most farmers feed three times per day, but there is a growing sentiment in favor of feeding but

twice per day. All grain is crushed or ground before feeding; the roughage is usually fed long, without moistening or steaming.

Farm No. 1.—Alfalfa hay, 20 pounds; corn fodder, 10 pounds; corn meal, 3 pounds; crushed oats, 3 pounds, and wheat bran, 1 pound. The alfalfa is fed morning and evening, about 8 or 12 pounds, respectively, the corn fodder at noon, and the concentrated feed in two equal feeds, morning and evening. In this instance all of the feed, with the exception of the wheat bran, is home-grown and the ration is not considered expensive.

Ration for dairy cows fed in Austria-Hungary (farm No. 1).

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Alfalfa hay	20	18.32	2.2	7.92	0.24	
Corn fodder	10	5.78	.25	3.46	.12	
Corn meal	3	2.673	.237	2.001	.129	
Crushed oats	3	2.670	.276	1.419	.126	
Wheat bran	1	.881	.122	.382	.027	
		30.324	3.085	15.192	.642	1:5.39

Nearly four-fifths of the dry matter and protein in this ration is obtained from the roughage. It has many features which should commend it to American farmers, particularly in the alfalfa-growing districts.

Farm No. 2.—This is a rather small farm near a large city, where the owner aims to keep one cow for each acre of land. Clover hay 16 pounds, oat straw 7 pounds, crushed oats 3 pounds, wheat bran 3 pounds, and linseed cake 2 pounds constitute the ration. The clover hay is fed in equal feeds, morning and evening, the oat straw at noon, and the concentrated feed in equal feeds morning and night. This ration gives very good results. It differs from the foregoing one in that the two principal sources of protein, wheat bran and oil cake, are purchased.

Ration for dairy cows fed in Austria-Hungary (farm No. 2).

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	16	13.552	1.088	5.728	0.272	
Oat straw	7	6.356	.084	2.702	.056	
Crushed oats	3	2.670	.276	1.419	.126	
Wheat bran	3	2.643	.366	1.176	.081	
Linseed cake	2	1.816	.586	.654	.140	
		27.037	2.400	11.679	.675	

Farm No. 3.—Alfalfa hay, 10 pounds; clover hay, 8 pounds; corn fodder, 10 pounds; crushed oats, 3 pounds; and corn meal, 3 pounds. The clover hay is fed in the morning, the corn fodder at noon, and the alfalfa hay at night. The grain is fed in one feed about 5 o'clock in the evening.

Ration for dairy cows fed in Austria-Hungary (farm No. 3).

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Alfalfa hay	10	9.16	1.10	3.486	0.12	.....
Clover	8	6.776	.544	2.864	.136	.....
Corn fodder	10	5.78	.25	3.46	.12	.....
Corn meal	3	2.673	.235	2.001	.129	.....
Crushed oats	3	2.670	.276	1.419	.126	.....
	.....	27.059	2.497	13.704	.631	1:6.28

DAIRYING IN GERMANY.

Dairying is easily the most important branch of the cattle industry in Germany, especially in the northern and western portions, where the influence of the Danish and Dutch farmers has been felt. The milk produced supplies creameries and cheese factories, condensed-milk factories, and the city milk trade, and a large amount of butter and cheese is made on the farms where the cows are kept. Some farms are rather heavily stocked, but usually only a small number of cows are kept on each farm. Practical men appear to give little thought to the preparation of rations or methods of feeding. With the exception of linseed and cotton-seed cake, practically all of the feed used is home grown or the by-products of home manufactures, such as sugar production and brewing.

Farm No. 1.—This farm is located in the northern part of Germany. Summer ration: Green clover, in season, 70 pounds; dried brewers' grains, 5 pounds, and linseed cake, 2 pounds.[a] At other times from 60 to 80 pounds of a mixture of oats and barley or peas, oats, and barley, with the same grain allowance, are fed. During the early fall about 30 pounds of sugar beets per cow daily are fed instead of part of the forage.

The winter ration is composed of clover hay, 20 pounds; oat hay, 8 pounds; corn meal, 3 pounds; dried brewers' grains, 3 pounds, and linseed cake, 2 pounds. The clover hay is fed in two feeds, morning and night; the oats hay, which is made by cutting oats about ten days before being ripe, is fed at noon. The grain is fed in two equal feeds—morning and night.

[a] On some farms cotton-seed cake is fed in summer instead of linseed cake.

Ration for dairy cows fed in northern Germany.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	20	16.940	1.360	7.160	0.340	.....
Oat hay	8	7.288	.344	3.712	.120	.....
Corn meal	3	2.673	.237	2.001	.129	.....
Dried brewers' grains	3	2.754	.471	1.089	.153	.....
Linseed cake	2	1.816	.586	.654	.140	.....
	.....	31.471	2.998	14.616	.882	1:5.54

Farm No. 2.—This farm is located near the city of Munich, and the owner uses large quantities of wet brewers' grains. Summer ration: At the time of the writer's visit the farmer was feeding 40 pounds of green alfalfa and about 60 pounds of wet brewers' grains per cow daily. The brewers' grains were fed early in the morning and about 5 o'clock in the evening. The mangers were cleaned out before each feeding time, to remove anything which might have been left over from the previous feed.

The cows were rather thin and their bowels very loose, but aside from this they showed every indication of thrift and health.

The winter ration on this farm is simple. It is composed of alfalfa hay, 16 pounds; wet brewers' grains, 40 pounds, and corn meal, 3 pounds. The alfalfa is fed in two equal feeds, immediately after milking morning and evening, the brewers' grains in two feeds, early in the morning and about 5 o'clock in the evening, and the corn meal at midday.

Ration for dairy cows fed near Munich, Germany.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds*	
Alfalfa hay	16	14.656	1.760	6.336	0.192	.....
Wet brewers' grains	40	9.720	1.560	3.720	.560	.....
Corn meal	3	2.673	.237	2.001	.129	.....
	.....	27.049	3.557	12.057	.881	1:3.95

Farm No. 3.—This farm is located near Berlin and the milk is sold to supply the city trade. The cows are stabled throughout the entire year and allowed out of doors only for a few hours each day in an open yard. At the time of the writer's visit, during the latter part of July, the ration was composed of alfalfa about 30 pounds, green peas, oats, and barley about 40 pounds, and a grain mixture

of 2 pounds wheat bran, 2 pounds corn meal, and 2 pounds cotton-seed cake.

Being near a sugar factory, the owner uses a great deal of beet pulp during the early winter. The following ration has been used with satisfactory results: Beet pulp, 80 pounds; alfalfa hay, 10 pounds; clover hay, 5 pounds; corn meal, 3 pounds; wheat bran, 2 pounds; and cotton-seed cake, 2 pounds. The beet pulp was fed in two feeds, in the early morning and before milking in the evening, the grain about 10 o'clock, the clover hay at 1 o'clock, and the alfalfa hay after milking.

Ration for dairy cows fed near Berlin, Germany.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Beet pulp	80	8.160	0.480	5.840		
Alfalfa	10	9.160	1.100	3.930	0.120	
Clover hay	5	4.235	.340	1.790	.085	
Corn meal	3	2.673	.237	2.001	.129	
Wheat bran	2	1.762	.244	.784	.054	
Cotton-seed cake	2	1.836	.744	.338	.244	
		27.826	3.145	14.713	.632	1:5.13

SWISS DAIRY METHODS.

The best and most profitable dairy farming in Switzerland is to be found in the more fertile districts of Zurich, Zug, Lucerne, and Schwytz. Here the land is considered too valuable for grazing, and all animals not in milk are sent to the mountains to graze during the summer. The milch cows are soiled or tethered on grass or forage lots during the summer and are maintained very simply during the winter. In winter hay may constitute the entire ration, and it is usually given in three feeds. Some feeders use a small amount of concentrated feed in addition to the roughage, or it is sometimes substituted for a small amount of roughage.

On one of the best farms visited the owner feeds the following ration during the winter: Morning, 8 pounds clover hay; noon, 6 pounds mixed hay; 5 o'clock, 3 pounds linseed cake, and at night, 14 pounds alfalfa.

Ration for dairy cows fed in Switzerland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	8	6.776	0.544	2.864	0.136	
Meadow hay	6	5.226	.354	2.454	.072	
Alfalfa hay	14	12.824	1.54	5.544	.132	
Linseed cake	3	2.724	.879	.981	.21	
		27.550	3.317	11.843	.550	1 : 3.94

On another farm the following winter ration is fed: Morning, 8 pounds clover hay; noon, 8 pounds clover hay; 6 o'clock, 2 pounds peanut meal, and at night, 12 pounds clover hay.

Another ration for dairy cows fed in Switzerland.

Feeding stuff.	Quantity.	Dry matter.	Digestible protein.	Digestible carbohydrates.	Digestible fat.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Clover hay	28	23.716	1.904	10.024	0.476	
Peanut meal	2	1.786	.858	.456	.138	
		25.502	2.762	10.480	.614	1 : 4.29

PART II.—SHEEP.

SHEEP FEEDING AND MANAGEMENT IN ENGLAND.

Sheep are raised in all parts of England regardless of the quality or rent of the land, and the greater part of the feed used is produced on the farms. In the southern and central parts of the country more use is made of pasture and forage crops for fall and winter grazing than is possible in northern England, where feeding must be done under cover. In some parts of the country forage crops are used during the summer and fall to supplement pasture, and cotton-seed and linseed cake are very generally fed at this time.

BREEDING SHEEP.

FEEDING THE RAM.

The feeding and management of the ram during the breeding season varies according to the time of the year, the condition of the ram, and the methods of handling him during the mating season.

Dorset breeders turn the rams with the ewes in June; with other breeds the usual season is from September 1 to October 20. To produce show lambs some breed in August, and some Hampshire and Suffolk breeders breed all their ewes during this month.

The ram may be allowed to run with the ewes (a quite common practice); he may be housed during the day and allowed to run with them at night, or the ewes may be brought to him for service. Rams which are carrying an unusual amount of flesh are always "conditioned" for a few weeks before being used by being given regular and abundant exercise and very light rations. In addition, the best breeders usually give one or two doses of Epsom salts.

Rams which run with the ewes usually receive about 1 pound per day of a mixture of bran and oats. Feeds rich in protein are used, and starchy feeds or those rich in oil avoided, as they are inclined to heat the system and produce flabby flesh. Rams which are housed during the day and allowed to run with the ewes at night are nearly always fed green feed, and from ¾ to 1 pound of oats and bran. When a ram stands for service the best breeders prefer giving him the run of a grass lot at night for exercise. Rams are liberally

fed during the breeding season, but are never kept fat or in a soft, flabby condition. At other seasons of the year than mating time grass, forage, and root crops are used, and as much feeding as possible is done out of doors; regular exercise is regarded as necessary.

As soon as the breeding season is over the rams are separated from the rest of the flock and given a small grass lot of their own. Young rams, or mature ones which have done a heavy season's service, are usually given from ½ to 1½ pounds of grain per day, depending on age and condition. As winter comes on the rams are kept on pasture as much as possible.

In the northern part of the country rams are kept out of doors a great deal, but the feeding is more liberal. Mangels are very seldom fed to rams, turnips being the chief source of succulent feed. During spring and summer rams are at pasture the greater portion of the time, but have green forage as needed in addition to grass. Grain is fed on some farms just before the breeding season.

CONDITIONING THE EWES FOR MATING.

A great deal of attention is given to the proper conditioning of the ewe previous to mating her with the ram, and practically all successful breeders "flush" their ewes for a few weeks before mating. This is done by increasing the feed. Ewes so treated will take the ram sooner than others, which is a decided advantage on those farms where early lambs are desired, and the entire number of ewes will come in heat within a shorter period, thus enabling the owner to have all of his lambs dropped within a few weeks' time, a factor which is often very beneficial when they are to be marketed. Furthermore, on account of the increase in vigor and condition of the ewes, a larger percentage of lambs is obtained and they are much stronger.

Various feeds are used, and for convenience the discussion is arranged according to breeds.

Dorsets.—A successful breeder in Dorset, who is also an exhibitor and exporter, gives his ewes about ½ pound per head per day of either corn or beans. They are mated in June.

Hampshires.—A most successful Wiltshire breeder of Hampshires uses cabbage, rape, and a small allowance of linseed cake for about two weeks previous to mating. His ewes are turned with the ram about the 7th of August.

Leicesters.—A successful breeder in Yorkshire uses good pasture or folds his ewes on thousand-headed kale, rape, or cabbage.

Lincolns.—A Lincolnshire breeder who has a most enviable reputation as a breeder of high-class sheep for show and export uses clover aftermath, kale, or rape.

Oxfords.—A leading breeder and exhibitor in Oxford grazes his

ewes on second-crop clover for about two weeks previous to turning them with the ram.

SHROPSHIRES.—One of the most successful breeders in Shropshire folds his ewes on rape and turnips.

SUFFOLKS.—A prominent Suffolk breeder gives his ewes the best pastures on the farm and in addition folds them on rape, cabbage, kale, mustard, or any other green feed available.

WENSLEYDALES.—A successful breeder in Yorkshire uses rape or barley stubble which has been seeded to clover.

The flushing system has some disadvantages. Inducing the ewes to take the ram earlier than they otherwise would has a decided tendency to make them return for a second or third service, and in some instances they will not become pregnant at all. This is caused by the change in the methods of feeding, and it proved very troublesome at one time, but has finally been overcome. After some experimenting shepherds found that if kept on a rather scanty ration after breeding the ewes will settle, as a rule, with the first service. The majority of breeders smear the breast of the ram with some retentive color which marks each ewe as soon as bred, and she may then be removed from the flock. The short rations are maintained for about a month. As a safeguard, all ewes are returned to the ram about the time the second heat is due.

FEEDING THE PREGNANT EWE.

The methods of feeding the pregnant ewe up to within about three weeks of lambing show rather surprising diversity, especially as to the use of roots. Some men deem it a most dangerous practice to feed roots to ewes, especially during the last three months of gestation, while others who are equally successful even fold pregnant ewes on turnips, the regular exercise probably overcoming the troublesome effects of the feed.

Practically all breeders graze ewes at all times when the weather is favorable. Ewes in good condition seldom get any grain or cake until a couple of weeks before lambing. Thin ewes are generally separated from the remainder of the flock and given one-half pound of grain per head daily. The following brief outline conveys a general idea of the management of the ewes at this time.

An unusually successful Dorset breeder allows his ewes to run on pasture until September, when they are folded on cabbage and fed plenty of good clover hay.

A noted breeder of Hampshires allows his ewes the run of stubble fields and grass land during the day and folds them on turnips at night. From the middle of November till the first of December they are out four or five hours each day on grass and are folded in a dry lot, where they are fed clover hay twice each day.

A noted breeder of Leicesters simply pastures his ewes. As winter comes on they receive in addition a small allowance of roots, generally turnips, and a liberal allowance of cut sheaf oats.

A famous breeder of Lincoln sheep allows his ewes the run of a grass lot up to the first of December. He then puts them on turnips until about three weeks before lambing. While on turnips they get cut clover hay, oats, and linseed cake in addition. They are fed what hay they will eat up clean and from one-half to 1 pound of grain per head per day.

A well-known Oxford breeder divides his ewes into flocks of about thirty in each, and allows them the run of the pasture lots with frequent changes. In open weather no additional feed is given. This breeder does not use any turnips or other roots until a few days before the lambs are expected.

A successful breeder of Shropshire sheep allows his ewes the run of a grass lot and a liberal allowance of dry feed in addition. They are given all the clover hay they will eat and about two-thirds of a pound per head daily of a mixture of oats and bran. He is a strong advocate of feeding plenty of dry feed but no roots until the lambs arrive.

A breeder of Suffolks uses grass, and in addition folds the ewes for a few hours each day on rape, cabbage, kale, or mustard up to about the 20th of October. After that they are allowed the run of stubble fields and grass land during the day and are folded on cabbage at night; this is followed by folding on white turnips and giving several hours each day on grass and stubble.

FEEDING THE EWES AT LAMBING TIME.

The methods used at this time are very much the same on all sheep farms, whether breeding stock or market mutton is the object. Hay is usually cut or chaffed. From 8 to 18 pounds of roots per head are given daily. Common grain rations are: Equal parts by weight of oats, bran, and linseed cake; one part oats, one part bran, and two parts linseed cake, or equal parts of cotton cake and oats. The amount fed varies from one-half pound to 1 or 1½ pounds per ewe per day.

FEEDING THE EWES AND LAMBS BEFORE WEANING.

Ewes suckling lambs have liberal rations of grain and cake and abundant forage on temporary pasture, so that as little risk as possible is run by the lambs contracting parasitic troubles. As is well known, one means to combat stomach worms is to keep lambs off old pastures. On many farms the ewes are divided, those with twin lambs being placed in one lot and those with singles in another, ewes with twin lambs being fed more heavily.

A brief outline of methods of feeding is given below:

A breeder of Dorset sheep who produces October lambs, the majority of which are marketed for the Christmas trade, feeds as follows: Ewes with twin lambs get 2 pounds per head per day and ewes with single lambs 1 pound of a mixture of equal parts by weight of oats and cotton cake, in addition to grass and green forage. As soon as they will eat, the lambs are fed a mixture of oats, bran, and linseed cake, equal parts by weight, and are finished off with beans or peas and linseed cake. The amount fed depends on what the lambs will eat, commencing with about one-eighth of a pound per lamb per day and finishing with from three-quarters pound to 1 pound or more. The finishing feed is given during the last three or four weeks previous to marketing.

A breeder of Leicesters gives his ewes a mixture of linseed cake, cracked peas, bran, and dried brewers' grains. Ewes with single lambs get three-fourths pound per ewe per day of the mixture, while those with twin lambs get 1¼ pounds per ewe per day. All of his lambs are fed a small allowance, seldom exceeding one-half pound per day, of a mixture of equal parts linseed cake, cracked corn, and crushed oats.

A noted Lincoln breeder gives his ewes no other feed than soiling crops and pasture. Single lambs are not fed any concentrated feed, but all twin lambs receive a daily allowance of oats and linseed cake.

A prominent breeder of Suffolk sheep feeds his ewes with single lambs three-quarters of a pound of a mixture of equal parts of oats, linseed cake, and bran per ewe per day, and his ewes with twin lambs 1 pound per ewe per day of the same mixture. His ewes are divided: those with single lambs have no additional feed, but all with twins have grain feed from the time the lambs are 2½ weeks old.

Some breeders of purebred sheep divide the ram and ewe lambs when a few weeks old and feed liberally on grain. On some farms all ewe lambs intended for breeding purposes are fed very sparingly on grain, only oats and bran being given, especially when they are to be retained on the farm. At weaning time the grain rations are withheld from the ewes, and they are placed on a short pasture. This is done for the twofold purpose of drying off the milk and also to keep them in a moderate condition until it is time to prepare them for the mating season. They are taken from the short-grass lot and fed on such rations as have been previously described for "conditioning" ewes.

FEEDING THE LAMBS AFTER WEANING.

Lambs are weaned at the age of 3 or 4 months, and the greatest care is taken to prevent any setback or standstill at this time. The

general tendency is to wean as early as possible, so that if the ewes are on permanent pastures the lambs can be taken away before parasites make themselves known. Breeders usually have some choice green feed at this time, so that the growth of the lambs will not be retarded. When the weaning season occurs about the same time that the grain fields are being cleared of their crops, many farmers run the lambs on the stubble fields, with green feed and grain in addition. Frequent changes of grazing ground are desired.

Although some men fold their lambs on green feed, the practice is not a good one in the opinion of the most successful breeders. This is especially true where they are folded on small areas at a time, as they then do not get sufficient exercise and take on fat too rapidly. The most highly commended practice is to allow the lambs the run of the stubble fields the greater portion of the day, with but a few hours in the forage lot, or to cut a small amount of forage from time to time and give the lambs free access to it from the stubble fields.

One of the first things done at weaning time is to divide the lambs into two or three bunches. Wether lambs, or ewe lambs not fit for breeding, are separated and put in a bunch by themselves and given different feed from those intended for breeding purposes. Rams and ewe lambs intended for breeding are separated, the rams to be more liberally fed than the ewes.

Many breeders sell their ram lambs in the fall of the year, but others prefer keeping them over and selling them as yearlings. Those intended for immediate sale are, as a rule, given better care and feed than those to be carried over the winter.

The following illustrates the methods of feeding from weaning time until the following spring:

A breeder of Hampshires who weans his lambs about June 1, when they are 4 months old, folds his ram lambs on vetches and sainfoin each day during June, in addition to giving them the run of a grass lot which has not been previously pastured with sheep, and a grain ration of oats, bran, and linseed cake. During July and the early part of August, until sale time, they are folded on cabbage and rape, with about 1 pound of grain. The ewe lambs are folded on vetches, cabbages, and rape, with no grain, unless the green feed is scarce, when one-third or one-half pound per day is given. From September until the 1st of May they are folded on turnips, swedes, and kale, with one-half pound per day of grain and straw, chaff, or clover hay.

A famous breeder of Lincoln sheep advocates liberal feeding and very frequent changes of pasture for lambs from weaning time until the following spring. He divides his lambs according to sex, but feeds all alike. The principal feeds used are green clover, tares, rape, and turnips. During the fall and winter they are folded on

turnips and fed all they will eat up clean of cut clover hay, in which is mixed about one-half pound per head per day of linseed cake.

A Shropshire breeder feeds as follows: At weaning time, which is about the 1st of June, when the lambs are 3 months old, they are divided into two flocks, the rams in one and the ewes in the other, and are given the best green crops available. Vetches are preferred, then clover, rape, kale, cabbages, early turnips, and swedes, in the order named. The lambs are always allowed the run of a new grass lot during the day for several hours, and when the crops are harvested they are changed to the stubble fields. When old mangels are available they are given for a few weeks, sliced. Some grain is fed, about one-eighth of a pound per day at the beginning and gradually increased so that when the lambs are 6 months old they are eating about one-half pound each per day. During the fall and winter they are pastured on turnips and have the same grain allowance, with as much good clover hay as they will eat at all times. This man always keeps rock salt in the troughs and sprinkles about one pound per day of common salt on the feed of each 75 lambs.

A breeder of Suffolk sheep who weans his lambs about the middle of June, when they are 4½ months old, feeds as follows: The ram lambs are separated from the ewes and fed on white clover, cabbages, rape, and kohl-rabi, cut and fed in troughs. In addition they have from one-half to 1 pound each of grain per day, the object being to push them along rapidly so that they will be of a good size at sale time, in August and September. The ewe lambs are put on trifolium and vetches, which are followed by rape, mustard, and cabbages, with the run of the stubble fields when ready. If in good condition no grain allowance is given, but if not, about one-third of a pound per day is fed. During the fall and winter they are fed on white turnips and swedes, with about one-half pound per head daily of grain and a liberal allowance of pea straw or clover hay. When the turnip supply is not sufficient, cut mangels are given in the spring.

The methods of feeding practiced on other farms are very similar to the foregoing. Green feed is always given during the summer and fall until the turnip crop is ready, then the turnips are the chief feed, with some form of roughage, usually clover hay, and a small allowance of grain and cake, which in nearly every instance is a mixture of oats, wheat, bran, and linseed cake.

FATTENING LAMBS FOR MARKET.

In the feeding and fattening of lambs for market rather distinct methods are pursued. Those who rear early lambs aim to grow them rapidly, so that they will be ready for market in June or the early part of July. The advantages claimed for this method are that it

yields quick returns, that the lambs are sold before parasites become troublesome, and that it gives an opportunity to purchase a bunch of sheep or lambs for fall feeding, thus increasing the sheep-carrying capacity of the farm and bringing in larger returns. Those who prefer late lambs believe that they do not require the same amount of attention as early lambs, that the ewes do not need so much special feeding, that warm sheds are not a necessity, and that the lambs can utilize the waste of the farm during the summer and fall, especially that of the stubble fields. Where late lambs are reared much care is necessary during the summer months, and old pastures must not be used as grazing grounds, as in them parasites are almost sure to attack the flock and cause serious losses.

In rearing early lambs the mothers are very liberally fed on clover hay, grain, and succulent feed. The amount of roots fed is surprising, in some instances as much as 20 pounds per ewe per day, but from 10 to 15 pounds daily is considered very liberal feeding. Winter rye, winter barley, and kale are utilized before the grass comes. The lambs are taught to eat grain at a very early age, most of them eating well at three or four weeks. Special lamb pens, or feeding creeps, are provided for this purpose. In some instances a self-feeder is used, but the majority of farmers prefer such feed fresh every day. The amount of grain fed is gradually increased until the lambs are eating from three-fourths to 1¼ pounds each per day, at three or three and a half months of age. This method of feeding is maintained even when the grass is abundant. The lambs are marketed when from 3 to 4 months old, weighing from 60 to 100 pounds each.

The more prevalent custom in feeding late lambs is to withhold all grain and utilize the pastures and stubble fields, with perhaps some green crops in emergencies, until after weaning time, which occurs in September. At that time lambs are generally folded on rape, kale, cabbage, or more often turnips. While close folding is not deemed advisable in the case of lambs intended for breeding, it is admirably suited to fattening purposes. In addition to the succulent feed supplied in the folds, the lambs are given a grain allowance of from three-fourths to 1¼ pounds each day. Cotton-seed or linseed cake or a combination of the two usually forms one-half to two-thirds of the concentrated feed. The remainder of the grain ration is oats, barley, beans, peas, or corn, depending on market prices. As a rule not much roughage is used in fattening lambs during the fall, but those who do furnish such feed use either clover hay or straw chaff. The chief reliance is placed on the use of green crops and roots, especially turnips.

FATTENING SHEEP.

The general tendency is to market lambs, but a considerable amount of sheep feeding still exists in all parts of the country. Some of these animals are natives, but a considerable number come from Ireland and Scotland, especially from the Scotch Highlands. The fall and winter methods of feeding are much the same as those practiced in lamb feeding. Folding on green crops or on the root crops is the general custom. In addition grain and cake are given to the extent of from 1 to 2 pounds per head per day. In some instances dried brewers' grains are fed with cake.

Where yard or shed feeding is practiced during the winter the ration usually consists of from three-fourths of a pound to 2 pounds per head per day of clover hay, mixed hay or straw chaff, from 12 to 20 pounds of roots, and from three-fourths to 1½ or possibly 2 pounds of grain and cake. Some farmers fatten their sheep on grass alone, feeding in addition cotton-seed or linseed cake, or a combination of the two, to the extent of from 1 to 1½ pounds per sheep per day.

SHEEP RAISING IN SCOTLAND.

Sheep, either as a specialty or as an important adjunct of the regular farming operations, are raised in all parts of Scotland. In the farming country, where the rent values are from $5 to $15 per acre, sheep are considered indispensable, as they not only generally give handsome returns in mutton and wool for the feed consumed and the labor expended, but they also increase the fertility of the soil. The Scotch farmer values sheep very highly as soil improvers. Although use of commercial fertilizers is very general in all parts of the country, the farmer who takes possession of a worn-out farm invariably resorts to sheep feeding as the surest and quickest method of enriching his land. On the hill and mountain land sheep are grown in large numbers. With high and well-drained land the conditions in Scotland are well suited to the production of sheep, as many parasitic troubles which so often cause heavy losses among the flocks of England are almost unknown in Scotland. The climatic conditions are favorable to the growing of roots, especially turnips, which form the basis of practically all sheep feeding. The fall and winter months are generally open and permit the grazing of the turnip crop, eliminating a great deal of labor in harvesting and saving the labor of handling the manure.

Sheep folded on turnips are always fed from ½ to 1¼ pounds each per day of grain and cake, this feeding being relied upon to enrich the manure. The influence of sheep husbandry on the fertility of the soil is generally recognized as of sufficient value to compensate for

the labor expended and for one-third of the total cost of the grain and cake fed. In some sections of the country the terms of the lease entitle a farmer who is giving up a farm to reimbursement for one-third of the total cost of all cake fed on turnip ground during the year. The influence of sheep feeding on the soil is so great that many farmers claim that they can not afford to be without sheep, even if they were to lose money on the mutton and wool produced. Two and three year old wethers are considered the most valuable and in-lamb ewes the least valuable to improve soil fertility.

The tendency now is to use younger sheep in feeding than in former years. The lambs grown on the arable farms are nearly all marketed under one year of age, while in former years they were fattened as yearlings and two-year-olds. The hill and mountain sheep are also finding an earlier market. The change in the age of feeding sheep has been brought about by the demand of the retail dealers for smaller carcasses to supply smaller cuts. Furthermore, mutton from young sheep can be sold at once, as it does not require several weeks to ripen, as is the case of that from two and three year old wethers.

FEEDING PUREBRED FLOCKS.

In the management of purebred flocks Scotch farmers, as a class, use more simple methods than those of England, and there is not the same tendency to force young sheep. The lambing season is later, both on account of the colder climate and because the absence of danger from parasites obviates the necessity of getting lambs off the pastures early; March and April are the usual months. In the management of breeding flocks breeders give plenty of natural feed, out-of-door exercise, and fresh air.

FEEDING BREEDING RAMS.

During the breeding season most of the breeding rams are allowed to run with the ewes night and day, and as a rule they receive no other feed than that obtained in the grass lot. Young and growing rams or old thin ones are often given some additional feed. The feed used varies on different farms; in some instances a mixture of linseed cake, oats, and bran is given, while on other farms oats alone, or oats and cabbage, are fed; about 1 pound per head daily of the grain mixture is fed. Outside the breeding season rams are fed moderately. During fall and winter they are on good pasture when the weather is favorable, and are given hay (clover preferred) and turnips or cabbage. Up to the opening of the breeding season rams are allowed the run of a grass lot, with no additional feed.

FEEDING BREEDING EWES.

In the feeding of breeding ewes good care and feed are given just previous to and at lambing time. Breeders, especially those who breed Border Leicesters, do not as a rule flush their ewes to the same extent as English breeders. Those who handle the Down breeds give more attention to this point, using meadow aftermath, stubble, cabbage, rape, or grain. After the ewes are safe in lamb they are not given additional feed to that obtained on pasture until the winter, when the best breeders allow ewes the run of a grass lot, feeding hay and cabbage or turnips in addition, without grain, until two or three weeks previous to lambing time.

Where early lambs are produced the ewes are fed very liberal rations just before lambing, being given a daily ration of clover hay to the extent of 1½ to 2 pounds, turnips 14 pounds, and from 1 to 1½ pounds of a mixture of equal parts of linseed cake, crushed oats, and bran. In some instances dried brewers' grains are given with linseed cake instead of oats and bran on account of the lower cost. The heaviest grain rations are always given to the ewes with twin lambs. The lambs are also taught to eat oatmeal or rolled oats, to which some linseed cake is added later on. After grass has made a good start, neither ewes nor lambs are given grain and cake until weaning. Ewes which lamb during the latter part of March and early in April are usually given some grain and cake for a few weeks, especially if the grass is backward in growth.

After the lambs are weaned the ewes are usually put on short pasture until the flow of milk has completely stopped, and in many instances remain there until the next breeding season.

FEEDING THE LAMBS AFTER WEANING.

The majority of lambs are weaned during August and September. In some instances they are allowed to run together until the middle of October, when the rams and ewes are divided. On other farms this division is made at weaning time. Grain is fed to all lambs regardless of sex for five or six weeks after weaning, so that they may have a good start and not lose the flesh made while suckling.

The following methods prevail on the most successful farms:

A breeder of Border Leicesters weans his lambs in August. After weaning the lambs all run together until the middle of October, have a good grass lot, usually meadow aftermath, and receive about one-half pound each per day of oats and linseed cake. When the ewes and rams are separated the rams are put on cabbage or turnips and are carried in this way all winter, but the grain is increased to 1

pound or 1½ pounds each per day. When the weather is open no hay is given, but in stormy weather or when snow is on the ground some clover hay or mixed hay is fed each day. The ewe lambs are allowed the run of a grass lot all fall and winter and have some turnips in addition fed on the grass. In some instances they are folded on a turnip patch for a few hours each day, but grain is never given. This breeder aims to have his rams well forward as shearlings at sale time, which is about the first of September. With the ewe lambs growth and a robust constitution are the points sought for.

On one of the largest and most successful Shropshire farms located in East Lothian, near Edinburgh, the manager weans his lambs during the first week in August, when the ewes and rams are separated. The ewes are put on second-crop clover until turnips are ready, when they are fed turnips on grass and have some hay in addition until the following spring. The ram lambs are better fed. They are grazed on second-growth clover, are fed cabbages or turnips, and have in addition from one-half to a pound of linseed cake and crushed oats each per day. During cold and stormy weather they are fed some clover hay.

PRODUCTION OF SHEEP ON THE HILLS AND MOUNTAINS.

In the south and southeast of Scotland the Cheviot is the popular hill sheep, while in the western, central, and northern portions of the country the hardy Black-faced Highland sheep is used. They furnish the chief source from which the farmers in the arable districts secure their feeding sheep.

The mountain and hill sheep are bred and grown for feeders, and the allowance of feed is only sufficient to maintain the older animals and furnish a rather scanty diet for growing ones. Therefore the sheep require considerable time to reach maturity. In former years they were practically all retained on the hills until 3½ years of age. They are now generally sold between 2½ and 3 years of age. Many of them are fed as lambs and are ready for the butcher before 9 months of age, and this system is growing in favor, but the great majority are sent down into the arable districts as lambs to be wintered, and are returned to the hills with the opening of spring, to be sold as feeders the following year. If it were not for this practice, yearling wethers would be fed generally, but the majority of hill sheepmen consider it too soon to send their sheep back in six months' time, and therefore retain them until 2½ years of age before marketing.

In some instances the lambs sent to the arable farms in the fall are not returned to the hills the following spring, but are either sold for immediate feeding or are grazed during the succeeding winter and summer to be sold later as yearling store wethers.

Grass, shrubs, and heather furnish the feed throughout the various seasons of the year. The ewes drop their lambs about the latter part of April or early in May, by which time the weather is usually favorable and there is sufficient grass to insure a good supply of milk. Neither ewes nor lambs get any other feed than grass throughout the summer and fall, and at weaning time the lambs are sent down to the arable districts to be wintered, so that they are not compelled to endure the hardships of a Highland winter. All other sheep, as a rule, are grazed on the hills and mountains throughout the entire year. The average period of usefulness of the ewes is about five years. When 5 years old they are generally taken from the flock and sent to the arable districts, where they are fattened or, what is a more common and profitable practice, bred to a first-class mutton sire. In the latter case they rear one crop of lambs. Both ewes and lambs are fattened for the early summer market. Young ewes not needed for breeding purposes are sold in the fall to feeders or to Irish hill farmers, who breed them to high-class mutton sires to produce feeding sheep.

FATTENING FOR MARKET.

The feeding of sheep and lambs for market is the most important branch of the Scotch sheep industry. The great bulk of the work is done during the fall and winter. Many farmers feed at this time of the year who do not keep any sheep on their farms throughout the remainder of the year, especially where very intensive farming prevails. In such cases the sheep or lambs are folded on the turnip fields. Where the land is not so valuable and rents are low, many farmers keep a large portion of the land under grass and feed sheep during spring and summer. There are a great many farmers who breed practically all of their own feeders, but these men either have cheap grazing land or they raise early lambs, which are grain-fed from the time they will eat until marketed, and others raise one crop of lambs from cast-off hill ewes, as already mentioned.

PRODUCING LAMBS FOR EARLY SUMMER MARKET.

In certain parts of Scotland considerable attention is given to the production of lambs for the early summer market. Those farmers who are making a success of this have warm pens for the ewes and lambs, and give the ewes very liberal rations, and the lambs are fed grain and cake as soon as they will eat. The lambs are dropped during the latter part of January and February and are forced until May or June, when they are marketed. The ewes are fed from 1½ to 2 pounds each per day of clover hay, from 12 to 16 pounds of turnips, and from 1 to 1¾ pounds of a mixture of wheat bran, crushed oats,

and linseed cake; the larger allowances are fed to those with twin lambs. The lambs are fed in creeps and are given all they will eat of oatmeal or rolled oats at first, and later on crushed oats, cracked corn, and either linseed or cotton-seed cake. Lambs at four weeks old will eat about an eighth of a pound each day, while at three months they will take from two-thirds to 1 pound each. When fed in this manner they make very rapid growth and are always well fleshed.

FATTENING HILL AND MOUNTAIN EWES AND LAMBS.

When hill and mountain ewes are bought to be bred to a mutton sire for one crop of lambs, they are bred to drop their lambs in March, and during pregnancy are given the run of grass or stubble land, with some turnips, so as to be in fair condition at lambing time. A few weeks previous to lambing they are fed oats and linseed cake, or brewers' grain and linseed cake. From lambing time they are fed well until marketed, the lambs having the same ration as soon as they are old enough to eat it. Grain and cake is given until grass is good, but after that time cake alone is fed, the amount varying from one-third to three-fourths of a pound per lamb per day, and from three-fourths pound to 1¼ pounds per ewe per day. The lambs are marketed when from three to four months of age, and if ready the ewes go at the same time, but generally they require about four weeks more liberal feeding on cake to finish them.

FATTENING LAMBS FOR MARKET.

Lambs for fall and winter feeding are usually purchased in the month of September, or if home bred are weaned at this time. They are first given the run of the stubble land for a few weeks and are gradually taught to eat turnips, and later are folded on the turnip land. In addition, they are fed cut hay and a liberal allowance of grain and cake, largely cake. When the lambs are on common turnips many successful feeders feed cotton cake and dried brewers' grains, equal parts by weight, to the extent of from one-half to three-fourths pounds per lamb per day. Should the roots be changed to swede turnips the grain ration is changed to 2 parts linseed cake, 1 part cotton-seed cake, and 1 part dried brewers' grains. Swede turnips are thought by sheepmen to be more difficult to digest than common turnips, and the addition of linseed cake is supposed to assist digestion. The grain allowance is increased during the finishing period, and may be changed to eliminate the brewers' grains, but cake is practically always used as a part of the ration. Some farmers do not put their lambs on the turnip land so soon, but first graze them for two or three months.

FATTENING SHEEP FOR MARKET.

The fall and winter methods of fattening sheep are very similar to those described for lambs. They are usually folded on roots with a grain-and-hay ration in addition. Roots are usually sliced for sheep which are teething. The amount of hay and grain is not large, but as much as 25 pounds of roots per head are fed daily. Practically all feeding is done in the open.

On lighter land, when a considerable amount is set aside for grazing, sheep are fed during the spring and summer. Some farmers fatten their sheep on grass alone, but the large majority feed some concentrate in addition, cotton seed or linseed cake being generally used. Some good feeders use a small amount of bran in connection with it, while others feed equal parts cotton seed and linseed cake. The amount varies from three-fourths to 1¼ pounds per head per day.

SHEEP PRODUCTION IN IRELAND.

With an abundance of grass and a temperate climate, the conditions of Ireland are very favorable to sheep raising. For years Irish farmers have given most attention to the production of sheep for feeding and the finishing of sheep on grass alone for market, but recently the breeding of purebred sheep and the fattening of sheep for mutton have increased, and this has resulted in the adoption of improved methods of feeding.

FEEDING PUREBRED FLOCKS.

The methods of feeding purebred sheep resemble those of England in some respects, but as a rule fewer forage crops are grown and a much more liberal use is made of grass, and smaller amounts of grain, hay, and succulent feeds are used. Throughout a great deal of the country grass alone in its season is the principal feed for breeding sheep.

THE PRODUCTION OF FEEDERS.

The production of feeding sheep is an important industry in Ireland. The tenant farmers, especially in the western and southern portions, grow some feeders each year, and although the number kept by each individual is generally small the total production is large. These sheep do not receive a great deal of care, but when the pastures are not too heavily stocked they do well. Winter feeding is not resorted to except in the case of a prolonged period of severe weather, which seldom happens.

In the mountains and hilly districts feeders are raised in a rather systematic manner. Large numbers of Black-faced Highland ewes

are annually purchased in Scotland and bred to high-class mutton sires. The Scotch ewes drop their lambs about the latter part of April or the first part of May, when the weather is warm and the grass abundant. They run on pasture at all seasons of the year, and are thus maintained very cheaply. The feeders are generally sold when 1½ years old.

FATTENING SHEEP FOR MARKET.

In central Ireland the fattening of sheep for mutton is receiving considerable attention. On good land nothing but grass is given, but where the soil is not so good and the yield of grass per acre less some additional feed is usually supplied. The principles are practically the same as those of English feeders, smaller amounts usually being fed. One very successful ration is equal parts of cotton-seed cake, linseed cake, and cracked corn. The length of the feeding period varies from sixty to one hundred and fifty days, depending on the condition and age of the sheep and the condition of the markets.

THE SHEEP INDUSTRY OF FRANCE.

The sheep industry of France is quite extensively developed. The Merino, in some form, is bred for wool, and the British mutton breeds and their crosses on Merino ewes are used for mutton. These crossbred sheep generally show a strong inclination toward the Merino type, and in the opinion of the leading French farmers this quick reversion to the Merino type is due largely to the methods of feeding. When introduced into France, bred pure, and maintained in small flocks, with plenty of green feed and grain, the British breeds have done equally as well as in England, but under more adverse conditions they seem very soon to lose those characteristics which have won for them so much praise in the mother country.

In some parts of the country sheep are given rather scanty rations during the winter and are pastured during the milder seasons of the year. Where there are no fences they are confined in sheds and yards during the growing season. Some farmers yard their sheep at night and herd them during the day. The French farmers, as a rule, do not grow many special crops for their sheep. Clover and alfalfa hay and straw are fed during the winter, with grain or cake and roots when available. The spring, summer, and fall rations consist of grass, forage crops, cabbage, and roots.

During the breeding season the rams are allowed to run with the ewes and subsist on the same rations, or they are confined in sheds, where the ewes are brought to them for breeding. The latter method prevails on the best sheep farms, especially those of the French

Government, where Rambouillets are bred. When rams stand for service they are fed clover or alfalfa hay, roots or cabbages, and a liberal allowance of oats, bran, and linseed cake.

On a large number of farms, especially those where Merinos are maintained, the ewes are bred during August or the early part of September, during which time they are confined to their sheds or yards. No special feeding is done. Later in the season when they are safe in lamb and the fields are cleared of their crops they are given the run of the grass and stubble fields. Some farmers who are breeding Southdowns follow the English methods more closely, and provide roots and other succulent feed in large quantities.

As the lambing season approaches all ewes are fed more liberally. Lambs are not fed while suckling, except on farms where the English mutton breeds are raised.

Where grass is available it is the principal feed in fattening. Soiling crops are also utilized, and in some instances grain and cake are used during the summer; small grain rations are the rule. Considerable winter feeding is done, the rations used being very simple. Some feeders use a ration composed of 1 to 2 pounds of clover hay and 1 to 1¾ pounds of a mixture of corn and wheat bran per head daily. Other rations fed by good feeders are as follows: Alfalfa hay, 2 pounds; corn, 1 pound, and linseed cake, one-half pound per sheep per day; mixed hay, 1½ pounds; oats, one-half pound; cotton-seed cake, one-half pound, and wheat bran, one-half pound per sheep per day. As a rule the amount of roughage given is about 1½ pounds per sheep per day, while the grain ration varies from 1 to 2 pounds.

PART III.—HOGS.

In practically all European countries considerable attention is given to the production of hogs. As a rule, farmers are not engaged in the industry as a specialty. The prevailing custom is for each farmer to rear only enough pigs to utilize the waste of the farm, but where dairy farming is followed as the chief occupation pigs are reared and fed in considerable numbers as an auxiliary industry. The two industries go hand in hand, and to all appearances neither one can be so successfully conducted alone as the two combined, especially in those countries which rank high in the production of high-class bacon. The real secret of success in European feeding for prime bacon is due to the large amounts of skim milk and buttermilk fed with grain and meal.

HOG RAISING IN ENGLAND.

Pigs are fattened for market in many districts. Both the fat and the bacon pig are produced, but most attention is given to the development of the bacon type. In Wiltshire the finest bacon in the world is produced, and very close discrimination on the part of packers in grading the pigs and paying for them according to quality has caused the farmers in these districts to use every possible precaution in feeding. In the production of fat or lard pigs much less skill is demanded of the feeder. Although the majority of farmers aim to produce either one type or the other, on some farms both types are produced. The fat pig is especially useful in utilizing damaged and cheap feed when skim milk is not available.

FEEDING THE BROOD SOW.

On the best farms the sows are often 12 months old before being bred. Two litters per year is the prevailing custom, and a good breeder is never discarded so long as she continues to rear good litters. The period of usefulness varies from three to eight years. The sows get exercise during the summer, and feed from pasture or a forage crop. Clover and alfalfa are both largely used, and many farmers use vetches and oats or peas and oats. In the milder parts of the country sows have exercise during winter on pasture, and in the colder districts special exercising pens are provided under cover. Raw or steamed mangels, beets, or turnips are fed in winter.

Previous to farrowing brood sows are fed moderately. Any fattening or heating feed is eliminated entirely from the ration or fed in very small quantities, and then in conjunction with cooling feeds, such as skim milk and bran. Within a week or so of farrowing time the principal part of the ration is decreased and the bran increased. Sometimes from 4 to 8 ounces of Epsom salts, according to the size of the animal, are given each sow about two days before farrowing.

During the suckling period, which varies from five to seven weeks, the sows are very liberally fed. Rations of equal parts bran, shorts, and barley meal, scalded and fed with skim milk, or two parts bran two parts middlings, one part barley meal, and one part corn meal, soaked or steamed and fed with or without skim milk, are in general use. The sows are always fed three times per day and in some instances four times per day. Skim milk and buttermilk are used whenever they can be had.

The young pigs are encouraged to eat at an early age. When they are three weeks old some milk and finely ground oatmeal or shorts are supplied in low troughs where they may get at it.

FEEDING THE BOAR.

In feeding the boar the general idea is to keep him in fair flesh and good health. Old boars are even kept in thin flesh. Exercise is given careful attention, both for the favorable influence which it exerts on the general health and on the condition of the feet and legs. During the summer the boar is on pasture, and during the winter he has an open yard for exercise. The best breeders are very strongly opposed to the use of any highly fattening feed. Corn is seldom used and when fed is nearly always fed with bran, oats, skim milk, and roots, and abundant exercise is given. When fed in this manner, especially in cold weather, it is not deemed to be injurious to the animal.

FEEDING YOUNG PIGS FOR BREEDING PURPOSES.

The young pigs are inspected at an early age, and those which promise to make useful breeding animals are separated from the rest and fed accordingly. The rations used are those that will develop bone and muscle, and skim milk or buttermilk is used by every breeder who can secure it, especially during the first four months of the pig's life. Linseed cake to the extent of about 10 per cent of the ration is fed by many breeders. Feed is generally soaked for several hours before feeding. Young pigs are usually fed three or four times per day.

FEEDING PIGS FOR BACON.

Many things are demanded in a good side of bacon. The thickness of fat on the back must not be too deep and must be uniform in all parts; the fat must not be oily or yellow in color, but must be a clear, bright white; the flesh must be firm, and the pigs should be uniform in size to insure uniformity of curing. These results are only obtained when uniformity, care, and good judgment are used in compounding rations and feeding them. Considerable latitude is permissible in the selection of feed, but the use of an undesirable one, even when combined with others which in themselves are very desirable, may depreciate the quality of what would otherwise become a very good carcass.

The writer is inclined to believe that pounds of gain in the bacon pig can not be produced as economically as in the case of the fat or lard hog. This is due to the fact that a much more limited range of feed can be used with safety in feeding the bacon pig, and some of the best feeds for the production of heavy gains, such as corn, must be fed with great care. Practically all the best bacon producers lay a great deal of stress on the use of dairy by-products. From the standpoint of quality of the bacon produced no rations have proved more satisfactory than barley meal and skim milk; shorts and skim milk; equal parts barley meal and shorts with skim milk; or equal parts ground peas, ground barley, and shorts with skim milk. All of these rations have produced good firm bacon, white in color and free from oil or flabbiness. Some feeders use equal parts ground barley and corn meal with skim milk or whey. This ration is said to produce heavier and more economical gains, but the quality of the product is inferior.

On some farms bacon pigs are grown as stores for four or five months, during which time they are on grass or forage crops and are fed grain rather lightly. They are then confined to the pens for about three months and are fed liberally. A great many successful farmers have their pigs ready for market at about 6 months old, which can be done to good advantage where skim milk is available.

FEEDING FAT OR LARD HOGS.

The farmers in all parts of England feed a considerable number of pigs to supply the demand for hogs for lard or sausage. They do not require so much skill in feeding as bacon pigs. Most of these pigs are marketed between the ages of 8 and 12 months, but there is always a demand, especially at Christmas time, for a limited number of heavy pigs. Amount of grain and economy of production are the two points which receive consideration.

HOG FEEDING IN IRELAND.

The larger farmers in Ireland are all more or less engaged in the production of pigs, but the industry particularly occupies the attention of the small tenant farmers. In some respects the conditions are very favorable for the successful production of swine, as dairy farming is so generally carried on that skim milk and buttermilk can be obtained on almost every farm. Were it not for the fact that such a large percentage of the country is in grass and that grain is not grown in large quantities, pigs would be produced in much larger numbers.

The bacon type is the only one raised, and the Irish farmers have been very successful, as they produce some of the best bacon in the world. With so many small farmers, each working independently, it is a rather difficult matter to control the quality of the product, and bacon curers find it difficult to secure uniform quality. However, methods of feeding are improving as a result of the work being done by the experts of the department of agriculture and technical instruction for Ireland. These experts are advising the use of feed which can be profitably combined with those available on the farm. The pigs are ready for market at from 6 to 8 months of age, when they weigh in the neighborhood of 200 pounds.

FEEDING BREEDING HOGS.

On the best-managed farms breeding animals are very well fed and cared for, but on many of the smaller farms the methods are very crude. An impetus has been given to better breeding by means of a plan whereby $25 premiums are awarded by the department of agriculture to good boars owned by farmers who are willing to allow the small tenant farmers the use of such animals at very low service fees, fixed by the department.

The best breeders allow their sows a considerable amount of exercise during the period of gestation to insure a strong healthy litter. Two litters are usually raised each year from each sow, and liberal rations are necessary. During the first half of gestation sows have pasture and a light ration of grain and cooked potatoes, after which time feeding is more liberal and skim milk is added. At farrowing and afterwards the management is similar to that of English breeders, with the exception of the potatoes.

Boars are given abundant exercise and kept in moderate flesh. Their management as well as that of young pigs is similar to the English method.

FEEDING PIGS FOR BACON.

The experts from the Irish department of agriculture are advocating the use of a ration composed of cooked potatoes, equal parts

shorts, ground barley, and corn meal to be fed with skim milk or buttermilk. They also recommend the feeding of some crushed oats during the last three or four weeks to whiten the fat and make the flesh firm. As a rule the pigs are fed three times a day and receive steamed feed during cold weather. Although some exercise is allowed during early life, the prevailing custom is to restrict it during the last two months.

HOG FEEDING IN DENMARK.

In no other European country has such a close study been made of pig production as in Denmark, and in no other country in the world has such uniformity of product been obtained. During the past seventeen years the Danish pig breeders have devoted their entire attention to the production of bacon. During that time they have captured the British bacon market by their careful methods of breeding and feeding and the quality of the bacon produced, and since 1888, the year when imports of Danish bacon were first reported by the British Government, they have received a considerably higher average price for their total output than any other country exporting bacon to Great Britain whose trade is enumerated in the official reports. All of their export bacon is sent to the British markets, and the trade has increased in this time from less than $7,000,000 to more than $18,000,000 annually.

These results are all the more striking when we bear in mind that less than twenty years ago the Danes were sending practically all of their hog products to Germany, Holland, Belgium, and France, countries which demand the fat type of pig. Although these markets furnished a fairly remunerative outlet for a time, the business was unprofitable, and Denmark decided to enter new markets, which demanded and paid for special products. The British markets were paying fancy prices for high-class bacon, especially that coming from Ireland, and the Danes saw a new opening for them, but they realized that in order to secure this trade it would be necessary to produce bacon equal to or better in quality than that from Ireland. Always willing to profit by the experiences of others, the Danish Government sent special experts to Ireland to study the methods of breeding and feeding the pigs from which this superior bacon was made. These experts had instructions to remain abroad until the desired information was obtained. They were successful, and since then the Danes have not only adopted Irish methods, but have improved upon them to such an extent that it is the Danish and not the Irish brand of bacon that now commands the highest prices on the British markets, notwithstanding the fact that Ireland has sent three special commissions to Denmark during the past ten years to ascertain, if possible, how it is accomplished. The chief advantage which the Danish

bacon has over that coming from other countries is its uniform quality. While in London the writer visited the Smithfield market and was shown there sides of bacon from various countries. Although in some instances better sides could be found in the bacon from other countries, in no instance did the product from any other country exhibit such a marked uniformity of quality and finish as that from Denmark, and it was unmistakably evident that very uniform methods are followed by the farmers of Denmark. The spirit of the people has a favorable influence in this, as in other lines of work. In Ireland there is a marked tendency for each farmer to work for his own interests regardless of results, but in Denmark the cooperative spirit prevails.

Another factor which is also responsible for the uniformity of the product is that dairy farming prevails in all parts of the country, and each farmer has a regular supply of skim milk and buttermilk for his pigs; these products are, moreover, pasteurized before leaving the creamery.

The prevailing custom is to confine in small pens all pigs intended for slaughter. Some exercise is given breeding stock, especially brood sows, but even with them it is limited when compared with that given in other countries.

FEEDING BREEDING HOGS.

Young pigs intended for breeding purposes receive somewhat better rations than older ones, but as all pigs intended for bacon must be carefully fed the breeding animals have to utilize kitchen refuse and other forms of cheap feed. Up to within six weeks of farrowing the brood sows are maintained on kitchen refuse, with some wheat bran, shorts, or crushed oats, a few roots in winter, and the run of a small grass lot in summer. In fact, almost any combination of feed which is economical and will keep the sow in a healthy condition is used. During the last six weeks of pregnancy the regular ration is increased somewhat and some ground barley given. This gets the sow in fairly good flesh by the time she has to suckle the litter. For a few days previous to farrowing the bran is increased and the other feed decreased. The ration is fed in the form of a thin slop. The feed is the same for about three days after farrowing. Then the sow is fed very liberally on grain and dairy by-products. The grain or meal is usually soaked for several hours in water and the milk is mixed in at feeding time. In cold weather many farmers warm the feed. The majority of farmers feed three times per day. The pigs are allowed to suckle from four to seven weeks and are always taught to eat by the time they are three weeks old.

Individual farmers, unless rearing pigs on a very extensive scale, do not keep boars of their own. The boars are practically all owned by pig-breeding societies, which keep them at their different stations, where the farmers may have the use of them at reasonable fees. This not only saves the expense of maintaining a boar, but it enables each farmer to select those boars best suited to his individual sows, and the litters are more uniform and of better type. These boars are well fed, but not in such a manner as to interfere with their usefulness. No feeds are used which have a tendency to produce obesity or a heated condition of the system, and succulent feed is usually supplied. Young pigs intended for breeding purposes are fed for bone and muscle. Succulent feed is usually given in small quantities, and in addition they receive a liberal allowance of skim milk or buttermilk and grain.

FEEDING PIGS FOR BACON.

As a rule pigs are marketed at about 6 or 7 months of age, when they weigh from 160 to 200 pounds, live weight. The Danish buyer demands pigs which are uniform in size, with an even thickness of fat on the back, which should be about three-fourths to 1 inch in depth. The fat should be clear white in color, the flesh firm in all parts, and there should be a high percentage of lean in proportion to the fat.

Any method of feeding which is undesirable will cause discrimination on the part of the buyers, and, through the existence of the cooperative bacon factories, which are owned by the farmers themselves, feeders are in very close touch with the work. They have an excellent opportunity to follow their pigs through the slaughterhouses and have the faults in the carcasses pointed out by experts. In this manner farmers have learned many valuable lessons, so that they are very well versed in the influence of different feeds and rations on the quality of the carcass. The seller is entitled to a report on each lot of pigs marketed, and if he has made any changes from the rations previously used he can ascertain whether or not they are desirable.

The following rations are used by successful feeders: Ground barley, cooked potatoes, and skim milk; shorts and skim milk; 2 parts shorts, 2 parts ground barley, 1 part corn meal, and skim milk; 2 parts ground barley, 1 part wheat bran, 1 part ground rye, and skim milk; 2 parts ground barley, 1 part ground oats, 1 part corn meal, and skim milk. Corn meal is fed with care, especially during warm weather; when fed in small quantities with barley, shorts, oats, and bran, combined with a liberal allowance of skim milk, there are no bad results. Some good feeders use corn meal to the extent of one-third or one-half of the grain ration during the first

three or four months and then omit it and finish with oats or similar feed. Feeders are sometimes compelled to use corn on account of the low price of bacon. Ground rye to the extent of about one-third of the ration gives good results, but rye shorts are not satisfactory and are only used in small quantities. The best feeds are ground barley, crushed oats, and wheat shorts. Roots are fed during winter and soiling crops during summer.

METHODS OF FEEDING IN AUSTRIA-HUNGARY.

The greatest amount of hog raising in the Austrian Empire is in southern Hungary, where the conditions are especially advantageous. Dairy farming prevails in practically all the arable sections, and the by-products are used extensively in pig feeding. Barley is the principal grain fed; corn shorts, bran, and milling by-products are used to some extent. Oats are seldom fed except to breeding animals. Cooked potatoes are very generally used and are very highly recommended, especially when fed with barley and skim milk. Grass and forage crops are not used much for fattening.

Pigs intended for market are well fed from the time they are old enough to eat, so that they will weigh 200 pounds at 6 months or from 300 to 350 pounds at 10 months.

FEEDING BREEDING HOGS.

Mature animals are fed sparingly, but growing ones are given liberal rations. Pasture crops, especially the legumes, are used very extensively during their season. In summer very little feed other than pasture is given to brood sows during the first half of the gestation period. During the winter they have beets or mangels, either raw or cooked. After this time wheat bran, shorts, mill stuffs, and oats are fed, the amount being small at first, but gradually increased. The meal is decreased for a week or so before farrowing, and is given in a thin, warm slop. This feeding is continued for a few days after farrowing. As soon as the sow has recovered she is fed liberally on skim milk and grain; cooked potatoes and corn meal are fed.

The pigs begin to eat skim milk and shorts or sifted barley meal when they are about three weeks old.

FEEDING PIGS FOR MARKET.

The Yorkshire has been extensively introduced and the bacon type of pig is bred in large numbers, but the same care is not observed in feeding as in Denmark. The people demand both bacon and sausage, and pigs which do not answer one purpose may be utilized for the

other. This simplifies feeding very materially. The market price of a feed and its efficiency to make gain are given more consideration than its influence on the quality of the carcass.

The following are representative rations: Ground barley 2 parts, shorts 1 part, mill stuffs 1 part, and skim milk; ground barley and corn meal, equal parts, and whey; corn meal, ground wheat, and crushed oats, equal parts, skim milk, and cooked potatoes. Some feeders steam or cook their feed at all seasons of the year. Those who do not steam the feed invariably soak it for several hours in water or whey. Skim milk is usually given after the principal part of the grain is eaten.

THE HOG INDUSTRY OF GERMANY.

Like other live-stock interests, the hog industry of Germany is somewhat limited and the home production does not meet the demand. All farmers raise a few pigs each year for their own use, but only a few make the business a specialty. When this is done, the methods of feeding are as good as those in England.

Dairy by-products are very generally used and potatoes and roots are fed in winter. Nearly all feeders soak meal before feeding and a great many strain it.

FEEDING BREEDING HOGS.

During the first half of gestation dry sows on grass do not have much additional feed; kitchen refuse may be all that is fed. After this time the methods of feeding are practically the same as those described for Austria-Hungary.

Breeding boars are fed green feed in summer and roots in winter, with grain, and are not allowed to become excessively fat. Young boars have skim milk as well and are never forced. They are usually fed four times daily until 3 months old.

Breeding pigs usually have the run of a small grass lot.

FATTENING RATIONS.

Some farmers endeavor to have their pigs ready for market at 6 months old, when they weigh about 200 pounds each. Others grow their pigs for about eight months and then fatten them for two and a half to four months, marketing them at 300 to 400 pounds. Those who finish at the younger age feed very liberally from the time the pigs begin to eat, and dairy by-products are always used if available. The rations generally contain ground barley and shorts during the first few months, corn meal, ground rye, ground wheat, or cooked

potatoes usually being added during the last month or six weeks. In the latter case kitchen refuse and dairy by-products are used before fattening begins, and very little grain is fed. When the fattening period arrives they are fed very heavy rations.

The following rations are representative: Equal parts ground barley and corn meal, with cooked potatoes and a little skim milk at the finish; equal parts ground barley, ground rye, and corn meal; ground barley 2 parts, ground wheat 1 part, ground rye 1 part. In some instances cooked roots are given.

Those feeds which will produce the greatest gains at the lowest cost are preferred, as it is the weight of the pig rather than the quality of the flesh which determines its market value. Fattening pigs are generally confined in small pens, especially during the finishing period.

HOG RAISING IN FRANCE.

Although most French farmers raise only enough hogs for family use and few for sale, in certain districts the industry is quite important. The conditions are very favorable, as barley is grown in all parts of the country and corn is produced in the warmer portions. Dairy farming is also very general in the northern and central portions and the by-products are available for feeding pigs.

FEEDING BREEDING HOGS.

Breeding animals are fed along similar lines to those of the best English breeders. Grasses, legumes, and other forage crops are especially utilized. Up to within a few weeks of farrowing time brood sows receive little or no grain, being maintained almost entirely on green crops, dairy by-products, and kitchen slops. During the last six weeks of gestation they receive crushed oats and shorts, or ground barley, fed as a slop. This is continued up to the last week, when the grain is reduced and bran or shorts, mixed with water to form a thin slop, is given. At this time many farmers give from 3 to 6 ounces of Epsom salts in the feed. After farrowing the light rations are continued for about four days. Young pigs intended for breeding purposes are fed on dairy by-products, succulent feed, and grain. The development of bone in these animals is given much attention, shorts or skim milk being fed with corn. Some breeders attain the same results with alfalfa and clover, but skim milk is preferred to overcome the objectionable feature of corn for young pigs.

FATTENING RATIONS.

Some farmers grow their pigs slowly for several months, and then fatten them quickly. This prevails among the small farmers, many of whom use no grain except during the last two months, the pigs being grown on dairy by-products and kitchen slops.

Those who make pig raising more of a specialty force them as rapidly as possible from the start. No special effort is made to produce high-grade bacon, and the feeds used are those which will give heavy gains. The most desirable market weight appears to be 300 pounds, and on many farms it is reached at the age of 8 to 10 months. A representative forcing ration is one of 2 parts ground barley, 1 part wheat shorts, and skim milk or buttermilk until the pigs are 6 months old, after which corn meal and cooked potatoes take the place of the shorts. The meal is usually steamed in winter and soaked in summer. Potatoes are always cooked. Some feeders use gluten feed with barley meal and skim milk when forcing young pigs. Artichokes are used extensively for fattening and are grazed.

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